Scientific and Technical Aerospace Reports

Volume 37
June 7, 1999

National Aeronautics and Space Administration
Langley Research Center

Scientific and Technical Information Program Office

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- Domestic and foreign dissertations and theses.

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Subject Divisions

Document citations are grouped first by the following divisions. Select a division title to view the category-level Table of Contents.

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F. Life Sciences
G. Mathematical and Computer Sciences
H. Physics
I. Social Sciences
J. Space Sciences
K. General

Indexes

Two indexes are available. You may use the find command under the tools menu while viewing the PDF file for direct match searching on any text string. You may also select either of the two indexes provided for searching on *NASA Thesaurus* subject terms and personal author names.

Subject Term Index
Personal Author Index

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01 Aeronautics (General) 1

02 Aerodynamics 1

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery. For related information, see also *34 Fluid Mechanics and Heat Transfer.*

03 Air Transportation and Safety 4

Includes passenger and cargo air transport operations; and aircraft accidents. For related information, see also *16 Space Transportation* and *85 Urban Technology and Transportation.*

04 Aircraft Communications and Navigation 6

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control. For related information, see also *17 Space Communications, Spacecraft Communications, Command and Tracking* and *32 Communications Radar.*

05 Aircraft Design, Testing and Performance 7

Includes aircraft simulation technology. For related information, see also *18 Spacecraft Design, Testing and Performance* and *39 Structural Mechanics*. For land transportation vehicles, see *85 Urban Technology and Transportation*.

06 Aircraft Instrumentation 13

Includes cockpit and cabin display devices; and flight instruments. For related information, see also *19 Spacecraft Instrumentation* and *35 Instrumentation and Photography.*

07 Aircraft Propulsion and Power 14

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and onboard auxiliary power plants for aircraft. For related information, see also *20 Spacecraft Propulsion and Power, 28 Propellants and Fuels*, and *44 Energy Production and Conversion*.

08 Aircraft Stability and Control 16

Includes aircraft handling qualities; piloting; flight controls; and autopilots. For related information, see also *05 Aircraft Design, Testing and Performance*.

09 Research and Support Facilities (Air) 17

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tubes; and aircraft engine test stands. For related information, see also *14 Ground Support Systems and Facilities (Space).*

Subject Categories of the Division B. Astronautics

Select a category to view the collection of records cited. N.A. means no abstracts in that category.

12 Astronautics (General) 18

For extraterrestrial exploration, see *91 Lunar and Planetary Exploration*.

13 Astrodynamics N.A.

Includes powered and free-flight trajectories; and orbital and launching dynamics.

14 Ground Support Systems and Facilities (Space) 18

Includes launch complexes, research and production facilities; ground support equipment, e.g., mobile transporters; and simulators. *For related information, see also 09 Research and Support Facilities (Air).*

15 Launch Vehicles and Space Vehicles 21

Includes boosters; operating problems of launch/space vehicle systems; and reusable vehicles. For related information, see also *20 Spacecraft Propulsion and Power.*

16 Space Transportation 21

Includes passenger and cargo space transportation, e.g., shuttle operations; and space rescue techniques. For related information, see also *03 Air Transportation and Safety* and *18 Spacecraft Design, Testing and Performance*. For space suits, see *54 Man/System Technology and Life Support*.

17 Space Communications, Spacecraft Communications, Command and Tracking 22

Includes telemetry; space communication networks; astronavigation and guidance; and radio blackout. For related information, see also *04 Aircraft Communications and Navigation* and *32 Communications and Radar.*

18 Spacecraft Design, Testing and Performance 22

Includes satellites; space platforms; space stations; spacecraft systems and components such as thermal and environmental controls; and attitude controls. For life support systems, see *54 Man/System Technology and Life Support*. For related information, see also *05 Aircraft Design, Testing and Performance*, *39 Structural Mechanics, and 16 Space Transportation*.

19 Spacecraft Instrumentation 28

For related information, see also *06 Aircraft Instrumentation* and *35 Instrumentation and Photography.*

20 Spacecraft Propulsion and Power 28

Includes main propulsion systems and components, e.g., rocket engines; and spacecraft auxiliary power sources. For related information, see also *07 Aircraft Propulsion and Power, 28 Propellants and Fuels, 44 Energy Production and Conversion,* and *15 Launch Vehicles and Space Vehicles.*

Subject Categories of the Division C. Chemistry and Materials

Select a category to view the collection of records cited. N.A. means no abstracts in that category.

23 Chemistry and Materials (General) 30

24 Composite Materials 31

Includes physical, chemical, and mechanical properties of laminates and other composite materials. For ceramic materials see *27 Nonmetallic Materials*.

25 Inorganic and Physical Chemistry 38

Includes chemical analysis, e.g., chromatography; combustion theory; electrochemistry; and photochemistry. For related information see also *77 Thermodynamics and Statistical Physics*.

26 Metallic Materials 47

Includes physical, chemical, and mechanical properties of metals, e.g., corrosion; and metallurgy.

27 Nonmetallic Materials 61

Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials. For composite materials see *24 Composite Materials.*

28 Propellants and Fuels 78

Includes rocket propellants, igniters and oxidizers; their storage and handling procedures; and aircraft fuels. For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power,* and *44 Energy Production and Conversion*.

29 Materials Processing 79

Includes space-based development of products and processes for commercial application. For biological materials see *55 Space Biology.*

Subject Categories of the Division D. Engineering

Select a category to view the collection of records cited. N.A. means no abstracts in that category.

31 Engineering (General) 106

Includes vacuum technology; control engineering; display engineering; cryogenics; and fire prevention.

32 Communications and Radar 110

Includes radar; land and global communications; communications theory; and optical communications. For related information see also *04 Aircraft Communications and Navigation* and *17 Space Communications, Spacecraft Communications, Command and Tracking*. For search and rescue see 03 Air Transportation and Safety, and *16 Space Transportation*.

33 Electronics and Electrical Engineering 113

Includes test equipment and maintainability; components, e.g., tunnel diodes and transistors; microminiaturization; and integrated circuitry. For related information see also *60 Computer Operations and Hardware* and *76 Solid-State Physics*.

34 Fluid Mechanics and Heat Transfer 121

Includes boundary layers; hydrodynamics; fluidics; mass transfer and ablation cooling. For related information see also *02 Aerodynamics* and *77 Thermodynamics and Statistical Physics.*

35 Instrumentation and Photography 127

Includes remote sensors; measuring instruments and gauges; detectors; cameras and photographic supplies; and holography. For aerial photography see *43 Earth Resources and Remote Sensing*. For related information see also *06 Aircraft Instrumentation* and *19 Spacecraft Instrumentation*.

36 Lasers and Masers 132

Includes parametric amplifiers. For related information see also *76 Solid-State Physics*.

37 Mechanical Engineering 137

Includes auxiliary systems (nonpower); machine elements and processes; and mechanical equipment.

38 Quality Assurance and Reliability 140

Includes product sampling procedures and techniques; and quality control.

39 Structural Mechanics 142

Includes structural element design and weight analysis; fatigue; and thermal stress. For applications see *05 Aircraft Design, Testing and Performance* and *18 Spacecraft Design, Testing and Performance*.

Subject Categories of the Division E. Geosciences

Select a category to view the collection of records cited. N.A. means no abstracts in that category.

42 Geosciences (General) 145

43 Earth Resources and Remote Sensing 146

Includes remote sensing of earth resources by aircraft and spacecraft; photogrammetry; and aerial photography. For instrumentation see *35 Instrumentation and Photography.*

44 Energy Production and Conversion 149

Includes specific energy conversion systems, e.g., fuel cells; global sources of energy; geophysical conversion; and windpower. For related information see also *07 Aircraft Propulsion and Power*, *20 Spacecraft Propulsion and Power*, and *28 Propellants and Fuels*.

45 Environment Pollution 154

Includes atmospheric, noise, thermal, and water pollution.

46 Geophysics 165

Includes aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism. For space radiation see *93 Space Radiation*.

47 Meteorology and Climatology 172

Includes weather forecasting and modification.

48 Oceanography 182

Includes biological, dynamic, and physical oceanography; and marine resources. For related information see also *43 Earth Resources and Remote Sensing*.

Subject Categories of the Division F. Life Sciences

Select a category to view the collection of records cited. N.A. means no abstracts in that category.

51 Life Sciences (General) 183

52 Aerospace Medicine 185

Includes physiological factors; biological effects of radiation; and effects of weightlessness on man and animals.

53 Behavioral Sciences 196

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

54 Man/System Technology and Life Support 197

Includes human engineering; biotechnology; and space suits and protective clothing. For related information see also *16 Space Transportation.*

55 Space Biology N.A.

Includes exobiology; planetary biology; and extraterrestrial life.

Subject Categories of the Division G. Mathematical and Computer Sciences

Select a category to view the collection of records cited. N.A. means no abstracts in that category.

59 Mathematical and Computer Sciences (General) 202

60 Computer Operations and Hardware 202

Includes hardware for computer graphics, firmware, and data processing. For components see *33 Electronics and Electrical Engineering.*

61 Computer Programming and Software 203

Includes computer programs, routines, algorithms, and specific applications, e.g., CAD/CAM.

62 Computer Systems 212

Includes computer networks and special application computer systems.

63 Cybernetics 214

Includes feedback and control theory, artificial intelligence, robotics and expert systems. For related information see also *54 Man/System Technology and Life Support.*

64 Numerical Analysis 217

Includes iteration, difference equations, and numerical approximation.

65 Statistics and Probability 220

Includes data sampling and smoothing; Monte Carlo method; and stochastic processes.

66 Systems Analysis 221

Includes mathematical modeling; network analysis; and operations research.

67 Theoretical Mathematics 221

Includes topology and number theory.

Subject Categories of the Division H. Physics

Select a category to view the collection of records cited. N.A. means no abstracts in that category.

70 Physics (General) 222

For precision time and time interval (PTTI) see *35 Instrumentation and Photography;* for geophysics, astrophysics or solar physics see *46 Geophysics, 90 Astrophysics,* or *92 Solar Physics*.

71 Acoustics 223

Includes sound generation, transmission, and attenuation. For noise pollution see *45 Environment Pollution.*

72 Atomic and Molecular Physics 226

Includes atomic structure, electron properties, and molecular spectra.

73 Nuclear and High-Energy Physics 233

Includes elementary and nuclear particles; and reactor theory. For space radiation see *93 Space Radiation.*

74 Optics 236

Includes light phenomena and optical devices. For lasers see *36 Lasers and Masers*.

75 Plasma Physics 238

Includes magnetohydrodynamics and plasma fusion. For ionospheric plasmas see *46 Geophysics.* For space plasmas see *90 Astrophysics*.

76 Solid-State Physics 251

Includes superconductivity. For related information see also *33 Electronics and Electrical Engineering* and *36 Lasers and Masers*.

77 Thermodynamics and Statistical Physics 268

Includes quantum mechanics; theoretical physics; and Bose and Fermi statistics. For related information see also *25 Inorganic and Physical Chemistry* and *34 Fluid Mechanics and Heat Transfer.*

Subject Categories of the Division I. Social Sciences

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80 Social Sciences (General) 269

Includes educational matters.

81 Administration and Management 269

Includes management planning and research.

82 Documentation and Information Science 272

Includes information management; information storage and retrieval technology; technical writing; graphic arts; and micrography. For computer documentation see *61 Computer Programming and Software*.

83 Economics and Cost Analysis N.A.

Includes cost effectiveness studies.

84 Law, Political Science and Space Policy N.A.

Includes NASA appropriation hearings; aviation law; space law and policy; international law; international cooperation; and patent policy.

85 Urban Technology and Transportation N.A.

Includes applications of space technology to urban problems; technology transfer; technology assessment; and surface and mass transportation. For related information see *03 Air Transportation and Safety, 16 Space Transportation*, and *44 Energy Production and Conversion.*

Subject Categories of the Division J. Space Sciences

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88 Space Sciences (General) N.A.

89 Astronomy 274

Includes radio, gamma-ray, and infrared astronomy; and astrometry.

90 Astrophysics 278

Includes cosmology; celestial mechanics; space plasmas; and interstellar and interplanetary gases and dust. For related information see also *75 Plasma Physics*.

91 Lunar and Planetary Exploration 280

Includes planetology; and manned and unmanned flights. For spacecraft design or space stations see *18 Spacecraft Design, Testing and Performance*.

92 Solar Physics 283

Includes solar activity, solar flares, solar radiation and sunspots. For related information see also *93 Space Radiation.*

93 Space Radiation 284

Includes cosmic radiation; and inner and outer earth's radiation belts. For biological effects of radiation see *52 Aerospace Medicine*. For theory see *73 Nuclear and High-Energy Physics.*

Subject Categories of the Division K. General

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99 General N.A.

Includes aeronautical, astronautical, and space science related histories, biographies, and pertinent reports too broad for categorization; histories or broad overviews of NASA programs.

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Typical Report Citation and Abstract

❶ **19970001126** NASA Langley Research Center, Hampton, VA USA
❷ **Water Tunnel Flow Visualization Study Through Poststall of 12 Novel Planform Shapes**
❸ Gatlin, Gregory M., NASA Langley Research Center, USA Neuhart, Dan H., Lockheed Engineering and Sciences Co., USA;
❹ Mar. 1996; 130p; In English
❺ Contract(s)/Grant(s): RTOP 505-68-70-04
❻ Report No(s): NASA-TM-4663; NAS 1.15:4663; L-17418; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche
❼ To determine the flow field characteristics of 12 planform geometries, a flow visualization investigation was conducted in the Langley 16- by 24-Inch Water Tunnel. Concepts studied included flat plate representations of diamond wings, twin bodies, double wings, cutout wing configurations, and serrated forebodies. The off-surface flow patterns were identified by injecting colored dyes from the model surface into the free-stream flow. These dyes generally were injected so that the localized vortical flow patterns were visualized. Photographs were obtained for angles of attack ranging from 10’ to 50’, and all investigations were conducted at a test section speed of 0.25 ft per sec. Results from the investigation indicate that the formation of strong vortices on highly swept forebodies can improve poststall lift characteristics; however, the asymmetric bursting of these vortices could produce substantial control problems. A wing cutout was found to significantly alter the position of the forebody vortex on the wing by shifting the vortex inboard. Serrated forebodies were found to effectively generate multiple vortices over the configuration. Vortices from 65’ swept forebody serrations tended to roll together, while vortices from 40’ swept serrations were more effective in generating additional lift caused by their more independent nature.
❽ Author
❾ *Water Tunnel Tests; Flow Visualization; Flow Distribution; Free Flow; Planforms; Wing Profiles; Aerodynamic Configurations*

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SCIENTIFIC AND TECHNICAL AEROSPACE REPORTS

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VOLUME 37, JUNE 7, 1999

01
AERONAUTICS (GENERAL)

19990040214 NASA Langley Research Center, Hampton, VA USA
Aeronautical Engineering: A Continuing Bibliography with Indexes, Supplement 400
May 14, 1999; 63p; In English
Report No.(s): NASA/SP-1999-7037/SUPPL400; NAS 1.21:7037/SUPPL400; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

This report lists reports, articles and other documents recently announced in the NASA STI Database.

Author

Aeronautical Engineering; Bibliographies

19990040627 NASA Langley Research Center, Hampton, VA USA
An Overview of Recent Developments in Computational Aeroelasticity
Bennett, Robert M., NASA Langley Research Center, USA; Edwards, John W., NASA Langley Research Center, USA; 1998; 15p; In English; 29th; Fluid Dynamics Conference, 15-18 Jun. 1998, Albuquerque, NM, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Report No.(s): AIAA Paper 98-2421; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

The motivation for Computational Aeroelasticity (CA) and the elements of one type of the analysis or simulation process are briefly reviewed. The need for streamlining and improving the overall process to reduce elapsed time and improve overall accuracy is discussed. Further effort is needed to establish the credibility of the methodology, obtain experience, and to incorporate the experience base to simplify the method for future use. Experience with the application of a variety of Computational Aeroelasticity programs is summarized for the transonic flutter of two wings, the AGARD 445.6 wing and a typical business jet wing. There is a compelling need for a broad range of additional flutter test cases for further comparisons. Some existing data sets that may offer CA challenges are presented.

Author

Aeroelasticity; Transonic Flutter; Applications Programs (Computers); Computerized Simulation; Airfoil Oscillations

02
AERODYNAMICS

Includes aerodynamics of bodies, combinations, wings, rotors, and control surfaces; and internal flow in ducts and turbomachinery. For related information see also 34 Fluid Mechanics and Heat Transfer.

19990038347 Technische Hogeschool, Dept. of Aerospace Engineering, Delft, Netherlands
Effect of Sideslip on the Flow over a 65 deg Delta Wing ***Final Report***
Verhaagen, Nicolaas G., Technische Hogeschool, Netherlands; Jan. 1999; 61p; In English
Contract(s)/Grant(s): F61708-97-W0239
Report No.(s): AD-A361146; EOARD-SPC-97-4067; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

Flow visualization tests, surface-pressure measurements and balance tests were conducted on a model of a flat plate 65 deg swept delta wing in a low-speed wind tunnel. The model was tested at a fixed angle of attack of 30 deg and at angles of sideslip up to 20 deg. The tests generated data that were used to study the effect of sideslip on the flow over the delta wing.

DTIC

Delta Wings; Sideslip; Flat Plates; Wind Tunnel Tests; Flow Distribution

19990040182 Paisley Univ., Paisley UK

Composite Structures. Special Issue: International Workshop on Experimental Techniques for Composite Structures, Volume 42

Marshall, I. H.; Aug. 1998; ISSN 0263-8223; 88p; In English; Experimental Techniques in the Analysis of Composite Structures, Sep. 1997, Paisley, UK

Contract(s)/Grant(s): F61708-97-W-0029

Report No.(s): AD-A361121; EOARD-CSP97-1005; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

These proceedings are a record of the International Workshop on Experimental Techniques in the Analysis of Composite Structures held at the University of Paisley, Scotland in September 1997. This workshop was jointly sponsored by the University of Paisley and the US Air Force European Office of Aerospace Research & Development (EOARD). The development of future military and civilian aerospace systems depends on new breakthroughs in advanced materials. Composite structures have become indispensable to aerospace designers who continually seek lighter weight, better heat resistance and lower cost alternatives to conventional materials. EOARD is proud to sponsor cutting-edge workshops such as this one that directly contribute to fundamental understanding of this vital material.

DTIC

Composite Structures; Thermal Resistance; Structural Analysis; Composite Materials; Conferences

19990040398 CSA Engineering, Inc., Palo Alto, CA USA

Aeroservoelastic Design with Distributed Smart Actuation System for High Performance Aircraft, *Jul. 1997 - Dec. 1998*

Oz, Hayrani; Dec. 1998; 65p; In English; Prepared in cooperation with Ohio State Univ., Dept. of Aerospace Engineering, Columbus, Ohio.

Contract(s)/Grant(s): F33615-94-C-3200

Report No.(s): AD-A361224; ASIAC-TR-98-04; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

This report describes the work done by the author to study the feasibility of shaping lifting surfaces via distributed smart actuation systems to achieve high performance flight configurations. In this report, the focus is on first obtaining and identifying optimal distributed-parameter-control equivalent actuation profiles for desired flight maneuvers by a modal synthesis approach. Subsequently, this distributed-parameter equivalent aeroservoelastic solution is to be implemented via a multitude of spatially-discrete actuators distributed throughout the domain of the lifting surface. The selection of the number and distribution of discrete actuators is to be based on optimal approximation solutions which use the optimal distributed-parameter-control equivalent solution as a guiding design. The insight to solutions are sought by considering the aeroservoelastic interactions among aerodynamics, structural flexibility and control actuators from the perspective of work-energy, control power, and control loading requirements. The aeroelastic modal formulation is presented in terms of real modal matrices and modal-state variables. Real bi-orthonormality relationships for aeroelastic modes are given with respect to structural matrices. The solution for distributed-parameter-control of an aeroelastic system is developed by modal synthesis from modal-state-space control inputs. In particular, the globally power optimal Independent Modal-Space Control (IMSC) technique is used for maneuver (set-point) control of an aeroelastic system by a modal-performance-output synthesis approach. Control power functionals for an aeroelastic system are defined for any actuation profile and control design.

DTIC

Aeroelasticity; Distributed Parameter Systems; Lifting Bodies; Active Control

19990040414 Aerospace Structures Information and Analysis Center, Wright-Patterson AFB, OH USA

Design Studies of Intermediate Complexity Wings

Apr. 1998; 27p; In English

Contract(s)/Grant(s): F33615-94-C-3200

Report No.(s): AD-A361258; ASIAC-TR-98-01; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Modern-day aircraft employ in the design stage a multidisciplinary process which involves the integration of several disciplines such as aerodynamics, structures, dynamics and controls. Structural optimization is performed to obtain minimum weight for improved performance of the aircraft at minimum cost. Weight reduction can also be achieved by optimizing the structure to meet flutter requirements and still be consistent with such requirements as strength and size constraints. Structural optimization generally involves definition of an objective function and a set of constraints as functions of the design variables. The weight is usually the objective function and the constraints are stresses, displacements, and aeroelastic instabilities such as flutter or divergence speed.

DTIC

Wings; Aerodynamics; Aeroelasticity; Design Analysis

19990040715 Naval Air Warfare Center, Aircraft Div., Patuxent River, MD USA

ACFD Applications to Predicting Store Trajectories

Cenko, A., Naval Air Warfare Center, USA; Aircraft Weapon System Compatibility and Integration; April 1999, pp. 1-1 - 1-10; In English; See also 19990040714; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

ACFD (Applied Computational Fluid Dynamics) is a tri-service project which has the purpose of verifying Computational Fluid Dynamics (CFD) tools for use by the aircraft-store certification organizations. The project is part of the Test Technology Development and Demonstration (TTD&D) program which is funded by the Office of the Secretary of Defense (OSD) Central Test and Evaluation Investment Program (CTEIP). During the past several years several CFD codes have been evaluated for their ability to predict store loads in aircraft flowfields at transonic speeds. The paper presents the latest results of these evaluations for store external carriage loads and trajectory predictions.

Author

Computational Fluid Dynamics; External Store Separation; Trajectory Optimization; Computerized Simulation; Applications Programs (Computers)

19990040718 British Aerospace Aircraft Group, Military Aircraft and Aerostructures, Preston, UK

A Method of Predicting Weapon Ballistics Prior to Flight Trials using Existing 6 DoF Modelling Techniques

Miles, K., British Aerospace Aircraft Group, UK; Akroyd, G., British Aerospace Aircraft Group, UK; Aircraft Weapon System Compatibility and Integration; April 1999, pp. 6-1 - 6-8; In English; See also 19990040714; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

The process of design and clearance of a modern military aircraft can span decades with the evolution of the design, build, testing and clearance phase leading to the final product. With the drive to shorten these timescales and reduce costs in order to supply the customer with an aircraft as early as possible, any reduction in this cycle time is advantageous. Although the tasks of ballistic modelling and safe separation share a fundamental methodology, in that they both deal with the trajectory of a weapon after it has separated from its parent aircraft, they have until recently been treated as two totally separate tasks. This paper outlines the benefits which can be accrued by using the safe separation models to provide trajectory data ahead of any flight trials. This includes benefits from reductions in both the ground based modelling and flight trials areas, and outlines how this work can improve the accuracy of ballistic data supplied prior to any flight trials work and improve ground impact patterns.

Author

Ballistic Trajectories; External Store Separation; Trajectory Analysis; Mathematical Models; Systems Integration

19990040719 Institute for Aerospace Research, Ottawa, Ontario Canada

Pressure Measurements on a F-18 Wing using PSP Technique

Tang, F. C., Institute for Aerospace Research, Canada; Lee, B. H. K., Institute for Aerospace Research, Canada; Ellis, F., Institute for Aerospace Research, Canada; Yeung, A., Institute for Aerospace Research, Canada; Lafrance, R., Institute for Aerospace Research, Canada; Aircraft Weapon System Compatibility and Integration; April 1999, pp. 7-1 - 7-14; In English; See also 19990040714; Original contains color illustrations; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

Surface pressure measurements on a 6% scale model of the F-18 have been carried out at the Institute for Aerospace Research 1.5m x 1.5m Trisonic Blowdown Wind Tunnel using the pressure sensitive paint technique. Model configurations included: (1) clean wing; (2) external fuel tanks with empty outboard pylons; and (3) external fuel tanks with two MK-83 and vertical ejection racks on the outboard pylons. In this investigation, pressure data on both the upper and lower wing surfaces as well as over the stores were obtained. The test was performed at a mean chord Reynolds number of 4 x 10(exp 6) and at Mach numbers ranging from 0.6 to 0.95. The angle-of-attack of the model was set at 0 deg and 4 deg nominally with leading and trailing edge flap angles at 0 deg. Detailed quantitative pressure distributions on the model wing surfaces were obtained. Effects of paint surface conditions and temperature variations on the accuracy of the measurements were assessed and are discussed here. The images obtained using the pressure sensitive paint technique also served as a very indicative flow visualization tool.

Author

Pressure Measurement; Pressure Distribution; Body-Wing Configurations; External Tanks; Wing-Fuselage Stores; Aerodynamic Interference; Wing Tanks; Paints; Flow Visualization; Flow Measurement; Wind Tunnel Tests

19990040721 Alenia Aeronautica, Turin, Italy

Alenia Approach to the Aerodynamic Integration of External Stores on Aircraft

Borsi, M., Alenia Aeronautica, Italy; Barbero, S., Alenia Aeronautica, Italy; Garigliet, E., Alenia Aeronautica, Italy; Pellandino, P., Alenia Aeronautica, Italy; Aircraft Weapon System Compatibility and Integration; April 1999, pp. 9-1 - 9-12; In English; See also 19990040714; Original contains color illustrations; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

The analysis of the store separation trajectories, finalised to the definition of safe release envelopes, is one of the most important tasks to overcome in the aerodynamic design area for the integration of external stores on a combat aircraft. With this paper, Alenia presents the methodologies used in this activity outlining the recent progress obtained with the availability of new advanced tools (Hardware and Software) in the field of CAD and digital image processing.
Author
Aerodynamic Configurations; External Stores; External Store Separation; Systems Integration; Computerized Simulation; Ballistic Trajectories

19990041081 NASA Ames Research Center, Moffett Field, CA USA
Reconstruction of a Three-Dimensional, Transonic Rotor Flowfield from Holographic Interferograms
Yu, Yung H., NASA Ames Research Center, USA; Kittleson, John K., NASA Ames Research Center, USA; AIAA Journal; February 1987; Volume 25, No. 2, pp. 300-305; In English; 23rd; Aerospace Sciences, 14-17 Jan. 1985, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Report No.(s): AIAA Paper 85-0370; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

Holographic interferometry and computer-assisted tomography (CAT) are used to determine the transonic velocity field of a model rotor blade in hover. A pulsed ruby laser recorded 40 interferograms with a 2-ft-diam field of view near the model rotor-blade tip operating of a tip Mach number of 0.90. After digitizing the interferograms and extracting fringe-order functions, the date are transferred to a CAT code. The CAT code, based on the filtered back-projection technique. then calculates the perturbation velocity in several planes above the blade surface. The values from the holography-CAT method compare favorably with previously obtained numerical computations near the blade tip. The results demonstrate the technique's potential for three-dimensional transonic rotor now studies.
Author
Velocity Distribution; Transonic Speed; Holographic Interferometry; Three Dimensional Models; Rotors; Flow Distribution

03
AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; and aircraft accidents. For related information see also 16 Space Transportation and 85 Urban Technology and Transportation.

19990039089 RAND Corp., Santa Monica, CA USA
Analyzing the Effects of Airfield Resources on Airlift Capacity
Stucker, James P.; Williams, Laura M.; Jan. 1999; 92p; In English
Contract(s)/Grant(s): DASW01-95-C-0059
Report No.(s): AD-A361431; RAND/DB-230-OSD; No Copyright; Avail: Issuing Activity (Defense Technical Information Center (DTIC)), Microfiche

Airlift capacity-the number of passengers and the number of tons of cargo that can be delivered to a specific location in a specific period of time-depends on the characteristics of (a) the cargoes to be delivered, (b) the airfields and the routes linking the cargo originations with the cargo destinations, (c) the ground resources at the airfields supporting the air assets, and (d) the air assets-i.e., the aircraft and the aircrews flying those routes. The major mobility studies performed by and for the Office of the Secretary of Defense (OSD) in the 1980s focused on the cargoes, the routes, and the air assets. In the 1990s the focus was expanded to include at least limited consideration of the en route, off-load, and recovery airfields. The air-mobility model of choice has become MASS (Mobility Analysis Support System), a large-scale simulation created and operated by the Air Force's Air Mobility Command (AMC). Ground resources are not modeled but are input as constraints to the airlift model. More recently a series of developments has led to the creation of NRMO (the Naval Postgraduate School/RAND Mobility Optimization), a large-scale linear-programming model of military airlift, and ACE (Airfield Capacity Estimator), a relatively high- resolution model of airfield resources and operations. This study demonstrates the combined use of the ACE and NRMO models to improve and facilitate the analysis of the effects of airfield resources on airlift performance.
DTIC
Airports; Loads (Forces); Cargo; Passengers

19990040172 Dayton Univ. Research Inst., Structural Integrity Div., OH USA
Statistical Loads Data for MD-82/83 Aircraft in Commercial Operations ***Final Report***
Skinn, Donald; Tipps, Daniel O.; Rustenburg, John; Feb. 1999; 80p; In English
Contract(s)/Grant(s): FAA-96-G-020

Report No.(s): AD-A361459; UDR-TR-98-00077; DOT/FAA/AR-98/65; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

The University of Dayton is supporting Federal Aviation Administration (FAA) research on the structural integrity requirements for the US commercial transport aircraft fleet. The primary objective of this research is to support the FAA Airborne Data Monitoring Systems Research Program by developing new and improved methods and criteria for processing and presenting large commercial transport aircraft flight and ground loads usage data. The scope of activities performed involved (I) defining the service related factors which affect the operational life of commercial aircraft; (2) designing an efficient software system to reduce, store, and process large quantities of optical quick access recorder data; and (3) providing processed data in formats that will enable the FAA to reassess existing certification criteria. Equally important, these new data will also enable the FAA, the aircraft manufacturers, and the airlines to better understand and control those factors which influence the structural integrity of commercial transport aircraft. Presented herein are analyses and statistical summaries of data collected from 3987 flights representing 7120 flight hours of six typical MD-82/83 aircraft during operational usage recorded by a single airline. The data include statistical information on accelerations, speeds, altitudes, flight duration and distance, gross weights, speed brake/spoiler cycles, thrust reverser usage, and gust velocities encountered.

DTIC

Commercial Aircraft; Information Retrieval; Transport Aircraft; Statistical Analysis; Research; Data Systems; Loads (Forces); Ground Tests; Dynamic Structural Analysis

19990040399 Army Safety Center, Fort Rucker, AL USA

FLIGHTFAX: Army Aviation Risk-Management Information. March 1999,Volume 27, Number 3

Mar. 1999; 12p; In English

Report No.(s): AD-A361225; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This periodical deals with all aspects of Army Aviation. Topics dealt with are Accountability, Leadership, Training, System Safety, Design Deficiency, and Accident Briefs.

DTIC

Management Information Systems; Information Management; Safety Factors

19990040401 Federal Aviation Administration, Office of Aviation Medicine, Washington, DC USA

A Survey of Pilots on the Dissemination of Safety Information *Final Report*

Rakovan, Lori; Wiggins, Mark W.; Jensen, Richard S.; Hunter, David R.; Mar. 1999; 70p; In English; Prepared in collaboration with Ohio State University, Columbus, Ohio and the University of Western Sydney, Sydney, Australia.

Report No.(s): AD-A361233; DOT/FAA/AM-99/7; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

A survey was conducted to obtain information from the pilot population on erections of safety-related training currently being offered, its usefulness, and the process through which it might be better disseminated to the general aviation population. The questionnaire assessed use of safety information, safety awareness, computer/video use, pilot self-assessment of proficiency, demographic information, and stressful experiences. In addition, four open-ended questions were included to allow pilots to freely express themselves on a variety of safety issues. The questionnaire was sent to 6,000 pilots (approximately 2,000 each to private, commercial, and airline transport) selected randomly from the pilot population. Responses were received from 1,822 (30.4% of the sample). of the respondents, 31.3% were private pilots, 34.2% were commercial pilots, and 34.5% were airline transport pilots. The frequency of response to all questionnaire items for the three certificate categories are provided, plus analyses of the responses of pilots in a target group consisting of all private pilots and those commercial pilots who had not flown for hire. Analyses also compared the responses of: (1) seminar attendees versus non-attendees, and (2) pilots who had been in accidents versus those who had not. Recommendations to improve the attendance of pilots at FAA-sponsored safety seminars are given.

DTIC

Information Dissemination; Aircraft Safety; General Aviation Aircraft; Air Transportation

19990040865 National Center for Atmospheric Research, Boulder, CO USA

Development of a Method to Test Holdover Times of Deicing and Anti-Icing Fluids in a Cold Room Using Artificially Generated Snow *Final Report*

Rasmussen, R. M.; Knight, C.; Hills, A.; Jan. 1999; 28p; In English

Report No.(s): PB99-129967; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A new method to test deicing fluids under laboratory conditions has been successfully demonstrated. This method generates artificial snow by grinding an ice core fed into a horizontal oriented rotating drill bit. The system is capable of producing snowfall rates from 5 to 50 gm/sq dm/hour over the area of a 30- x 50-cm frosticator plate. Since the snowfall rate can be accurately con-

trolled, other variables such as temperature and fluid type can be varied independently in order to determine the dependence of failure time on each of the variables separately. The current version of the system produces failure times shorter than outdoor and indoor test results of the same fluid type under similar conditions. Preliminary analysis suggests that this may be due to the continuous nature of the snow generation method used in the current system compared to the intermittent snow application techniques used in previous tests.
NTIS
Deicers; Antiicing Additives; Low Temperature Environments; Technology Assessment; Laboratories

19990040937 Goodrich (B. F.) Co., Akron, OH USA
Flight Tests of Ice Detection System
Janssens, Leo G., Goodrich (B. F.) Co., USA; The Society of Experimental Test Pilots Technical Publication; 1998; ISSN 0742-1508, pp. 5-26; In English; 14th, 15-16 Apr. 1998, Alexandria, VA, USA; Sponsored by Society of Experimental Test Pilots, USA; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

Ever since Jimmy Doolittle pioneered the concept of ”blind flying”, structural icing has been a major concern during instrument flying. Each year, many aircraft accidents are attributed to icing in low visibility, freezing weather. Most often, the evidence is destroyed along with the aircraft by the ground impact as a result of ice. Consequently, statistics showing ice as the primary cause of a specific accident are hard to assimilate. However an Aircraft Owners and Pilot’s Association (AOPA) study of light aircraft accidents for 1994 showed that in 53 total IFR accidents, eight (I 5%) included ice as a factor. Light single and multi-engine aircraft are the class of aircraft most involved in icing accidents because of their low speed, low altitude envelope where most of the ice producing clouds arc formed. The BFGoodrich Company has recently certified a low cost, low electrical power required ice detection system, called the SMARTboot System*, that is suitable for light aircraft. In the future, the system is intended to be adapted to commuter aircraft. The high performance, single engine Piper Malibu was selected for the SMARTboot System flight test task because of its capability to operate in the light plane, low altitude, low speed environment, and in the high altitude environment. The Malibu is pressurized and Federal Aviation Administration (FAA) certified to 25,000 feet. The Malibu is also one of a few single engine aircraft that is FAA approved for flight into known icing conditions. This paper describes the SMARTboot System components development, initial ground testing of the system in the BFGoodrich Icing Wind Tunnel (IWT), and the results of the flight tests in the Piper Malibu based at Akron, Ohio. Correlation of the results of the ground IWT and over II 0 hours of actual flight tests, mostly in icing conditions, is also presented. The data from flight tests proved that the SMARTboot System performed its intended function to improve the safety margin during flight in icing conditions.
Author
Ice Formation; Flight Tests; Detection; Flight Conditions; Freezing; Ground Tests; Safety; Ice Clouds

04
AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes digital and voice communication with aircraft; air navigation systems (satellite and ground based); and air traffic control. For related information see also 17 Space Communications, Spacecraft Communications, Command and Tracking and 32 Communications and Radar.

19990039166 University Coll. of Wales, Dept. of Physics, Aberystwyth UK
TEC Measurements for GPS Comparisons and Ionospheric Tomography ***Final Report***
Kersley, Leonard, University Coll. of Wales, UK; Pryse, S. E., University Coll. of Wales, UK; Lunt, N., University Coll. of Wales, UK; Jones, D. G., University Coll. of Wales, UK; Walker, I. K., University Coll. of Wales, UK; Jan. 1999; 85p; In English
Contract(s)/Grant(s): F61708-97-W0129
Report No.(s): AD-A361128; EOARD-SPC-97-4043; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

This report results from a contract tasking University of Wales as follows: The contractor will investigate the validity of the SCORE analysis processes for the determination of Global Positioning System (GPS) Total Electron Content (TEC), and also the contribution of the protonospheric section of the path of the propagation error budget.
DTIC
Global Positioning System; Tomography; Earth Ionosphere

05
AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes aircraft simulation technology. For related information see also 18 Spacecraft Design, Testing and Performance and 39 Structural Mechanics. For land transportation vehicles see 85 Urban Technology and Transportation.

19990040173 Military Academy, Operations Research Center, West Point, NY USA
Optimal Mix of Army Aviation Assets
Shupenus, Jon L.; Armstrong, James; Oct. 1998; 68p; In English
Report No.(s): AD-A361461; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

The Army plan for future heavy division attack helicopter battalion organization calls for a similar organization to that which exits today: three attack companies consisting of three scout helicopters and five attack helicopters each, for a total of nine scouts and 15 attack helicopters per battalion. The scout to attack helicopter ratio has been fairly Consistent over the last thirty years. With the current fielding of AH-64D Longbow Apache and development of RAH-6 Comanche helicopters, it seems worthwhile to evaluate the number and types of helicopters that should be assigned to the attack helicopter battalion. This project investigated the predicted combat effectiveness of a variety of attack helicopter battalion force structures. Both the AH-64D and theRAH-66 were investigated in scout attack roles at three or five helicopters per platoon, with a focus on survivability, lethality and detection capabilities. The analysis contained in this technical report uses experimental design, multiple scenarios, multiple replications and confidence intervals to robustly investigate various battalion designs in an attempt to determine the best attack helicopter battalion force structure to meet the demands of the Force XXI and Army After Next. This project required analysis of each of 16 design points in three high resolutions scenarios. These scenarios were developed in Janus 6.0 and an associated database was edited and refined to create advanced vehicles and aircraft which might be expected for a 2010 combat engagement. A full 2%4 factorial design of experiments, plus a base case, resulted in seventeen design points requiring evaluation. Ten replications of each design point in each scenario, along with a more detailed refinement of two missions, required over 600 combat simulation runs. Analysis of output data revealed that Army development plans for future attack helicopter battalion force structures seem to be on track. 14.
DTIC
Systems Engineering; Effectiveness; Operations Research; Military Helicopters; Attack Aircraft; Experiment Design; Armed Forces; Factorial Design

19990040186 Military Academy, Operations Research Center, West Point, NY USA
1998 Army After Next Unmanned Aerial Vehicle Studies
Sullivan, James F., Jr.; Brouillette, Gregory; Joles, Jeffery K.; Jul. 1998; 62p; In English
Report No.(s): AD-A361106; MA/ORC-TR-98-X; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

There has been growing recognition within the senior leadership of the Army that UAVs are an emerging technology which may play a critical role in the Army After Next. The CSA directed Army After Next (AAN) effort to frame issues vital to the development of the US Army after about 2025 and to provide those issues to senior Army leadership in a format suitable to integration into TRADOC Combat Development programs. The Army After Next Directorate and the Director of TRAC Leavenworth initially requested USMA to analyze a proposed notional UAV force structure and provide recommendations and alternatives. to date, USMA has been involved with the Tactical Wargames, conferences, In Progress Reviews, has conducted some initial modeling which has resulted in a UAV requirements analysis focused on the Battle Element, and has presented a final briefing to the Directors of the AAN, TRAC Leavenworth, and the Battle Lab Integration Technology and Concepts Directorates. Some potential key insights concerning the contribution of future Unmanned Aerial Vehicles (UAVs) systems have been brought to light.
DTIC
Remotely Piloted Vehicles; Pilotless Aircraft

19990040650 American Inst. of Aeronautics and Astronautics, Reston, VA USA
Wings: AIAA/Cessna/Student Design/Build/Fly Competition, Wichita, Kansas ***Final Report, 1 Apr. - 31 Dec. 1998***
Page, Gregory; Bovias, Chris; Selig, Michael; Paczula, Robert; Jan. 17, 1998; 778p; In English
Contract(s)/Grant(s): N00014-98-1-0493
Report No.(s): AD-A361001; No Copyright; Avail: CASI; A99, Hardcopy; A10, Microfiche

This report is made up of the combined reports of 17 separate teams of students who entered the 1998 Design, Build & Fly Competition. The objectives of the Design. Build & Fly Competition were to have students teams design, build and fly unmanned remote control electric aircraft designed for maximum range on a limited battery. A ”fly off” took place on the Westport Airport near Wichita, KS. in April 1998. Winners of the contest: 1st place. University of Southern California; 2nd, Texas A&M University;

3rd, Syracuse University. The Design, Build & Fly Competition was supported by Cessna the Office of Naval Research and the AIAA Foundation.
DTIC
Aircraft Design; Cessna Aircraft; Pilotless Aircraft; Remote Control

19990040714 Research and Technology Organization, Systems Concepts and Integration Panel, Neuilly-sur-Seine, France
Aircraft Weapon System Compatibility and Integration ***Compatibilite et Integration des Systemes d'Armes Aeroportes***
Aircraft Weapon System Compatibility and Integration; April 1999; 256p; In English; 3rd; Symposium of the Systems Concepts and Integration Panel, 28-30 September 1998, Chester, UK; Sponsored by Research and Technology Organization, France; See also 19990040715 through 19990040736; Original contains color illustrations
Report No.(s): RTO-MP-16; AC/323(SCI)TP/8; ISBN 92-837-0007-4; Copyright Waived; Avail: CASI; A12, Hardcopy; A03, Microfiche

Economic constraints dictate that the lives of existing aircraft must be stretched, making the incorporation of new weapons and weapon systems into existing airframes necessary. These same constraints dictate that the corollary is also true, i.e. that new aircraft must cope with existing weapons as well as their new systems. Along these lines, the goal of this symposium was to critically review the overall state-of-the-art in aircraft weapon system compatibility and integration for the benefit of researchers, RDT&E managers, engineers, and operational staff employed by both contractor and supplier organisations within NATO. Illuminating possible paths for future development and providing beneficial ideas and experience was achieved as part of the overall objective of the symposium. Also, the symposium explored both fixed and rotary wing applications as they related to the above mentioned session areas. Overall, the attendees were quite pleased with the presentations along with a very informative roundtable discussion.
Author
Conferences; Weapon Systems; Weapon System Management; Systems Integration; Fighter Aircraft; Systems Compatibility; Trajectory Analysis; External Stores; External Store Separation

19990040717 Naval Air Systems Command, Advanced Aerodynamics Branch, Patuxent , MD USA
F/A-18C Store Carriage Loads Prediction and Mutual Interference Aerodynamics
Kern, S. B., Naval Air Systems Command, USA; Findlay, D. B., Naval Air Systems Command, USA; Aircraft Weapon System Compatibility and Integration; April 1999, pp. 5-1 - 5-7; In English; See also 19990040714; Original contains color illustrations; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

A computational aerodynamics study of the integration of a variant of the Joint Direct Attack Munition (JDAM) store onto the F/A-18C aircraft was performed. Computational forces and moments, derived from hybrid Euler/Navier-Stokes solutions, correlated fairly well with available wind tunnel test data across a wide angle-of-attack range at both transonic and supersonic free-stream flow conditions. The computational results were analyzed to explore the aerodynamic influence of the store on an adjacent fuel tank, and the aircraft wing and fuselage. The addition of the JDAM caused a 16% reduction in the outboard yawing moment of the 330 gallon tank. The presence of the store had nearly no effect on the forward 30% of wing; however, there were significant effects on both the upper and lower surfaces of the wing aft of mid-chord. The influence of the store was so pervasive that it was detectable as far forward as the canopy and as far aft as the empennage.
Author
F-18 Aircraft; Computational Fluid Dynamics; Aerodynamic Interference; External Store Separation; Wing-Fuselage Stores

19990040722 Naval Air Warfare Center, Aircraft Div., Patuxent River, MD USA
Testing and Proving the GBU-24 Laser-Guided Bomb from the U.S Navy's F-14 Aircraft
Cable, B., Naval Air Warfare Center, USA; Piranian, A., Naval Air Warfare Center, USA; Zaccardi, V., Naval Air Warfare Center, USA; Aircraft Weapon System Compatibility and Integration; April 1999, pp. 11-1 - 11-10; In English; See also 19990040714; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

When the U.S. Navy identified the requirement to carry and employ the Texas Instruments-Raytheon GBU-24 Laser Guided Bomb (LGB) hard target penetrator from the F-14 aircraft, its weapons compatibility/certification engineers had to modify the weapons flight test process which had been in use for determination of F-14 aircraft and Air-to-Ground (A/G) weapons compatibility. That process consisted of beginning tests at low Mach/airspeed in straight and level flight, and continuing tests, at incrementally greater speeds, through the highest Mach/airspeed and steepest flight path angles, with the acceptability of the weapon separation trajectory evaluated through film from aircraft-mounted cameras. The GBU-24, because of its large size and large deploying wing, had to be evaluated through an integrated test and evaluation process consisting of computational analyses, wind tunnel testing, ground testing, flight testing and photogrammetric analyses, used interdependently, to determine the extent of air-

craft/weapon compatibility. The test process ultimately led to the authorization for all F-14 variants to carry and employ two GBU-24's on fuselage carriage stations. In addition, the testing led to authorization for launching of an AIM-7 Air-to-Air missile from a fuselage carriage station which was behind the LGB A/G weapons.
Author
Flight Tests; Laser Guidance; External Store Separation; Systems Integration; Systems Compatibility; Ballistic Trajectories; Weapon Systems; Weapons Delivery; Computerized Simulation; Trajectory Analysis

19990040724 Naval Air Warfare Center, Aircraft Division, Patuxent River, MD USA
The USA Navy's Integrated Approach to Store Separation Analysis
Taverna, Frank, Naval Air Warfare Center, USA; Cenko, Alex, Naval Air Warfare Center, USA; Aircraft Weapon System Compatibility and Integration; April 1999, pp. 13-1 - 13-8; In English; See also 19990040714; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

The current USA Navy approach to store separation analysis employs a combination of wind tunnel testing, flight testing, and computational aerodynamic analysis. This Integrated Test and Evaluation approach ensures safe separation of stores in a timely and cost effective manner. This approach has evolved over the past decade and is unique because it is performed by an Integrated Product Team (IPT) which belongs to one, physically co-located organization. During the past several years this approach has been responsible for providing considerable time and cost savings to many programs, including the F-18C/JDAM, F-14/GBU-24, F-18C/JSOW, and DC-130/BQM-74 programs. This approach is presently being applied to the F/A-18E/F aircraft/store integration program to both reduce the program cost and ensure the success of the program.
Author
Aerodynamic Characteristics; External Store Separation; Design Analysis; Systems Integration; Systems Compatibility; Computerized Simulation; Flight Tests

19990040725 Naval Air Systems Command, Patuxent , MD USA
F/A-18E/F Trajectory Improvement Study
Chaddock, Dale R., Naval Air Systems Command, USA; Aircraft Weapon System Compatibility and Integration; April 1999, pp. 14-1 - 14-12; In English; See also 19990040714; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

The original F/A-18E/F configuration based on preliminary analysis predicted the existence of a major store separation problem due to a more adverse flowfield than the F/A-18C/D aircraft. Several reasons contribute to the problem which include a wider fuselage, larger wing area and thicker wing, new inlet design with more inlet spillage, and an additional pylon station on each wing. The wing pylon stations were left at there original locations relative to the aircraft centerline. After extensive weapons separation testing and trajectory analysis in the AEDC 16T transonic wind tunnel, it was projected that the current aircraft configuration had a major separation problem and would not meet the E/F release and jettison specification requirements. Therefore, a major trajectory improvement study was undertaken to improve the release and jettison operational envelopes.
Author
Aircraft Configurations; Trajectory Analysis; Ballistic Trajectories; Jettisoning; Wing-Fuselage Stores; External Store Separation; F-18 Aircraft; Flight Tests; Wind Tunnel Tests

19990040726 Royal Australian Air Force, Aircraft Research and Development Unit, Edinburgh, Australia
Aircraft/Stores Compatibility: The Australian Perspective
Tutty, Malcolm G., Royal Australian Air Force, Australia; Aircraft Weapon System Compatibility and Integration; April 1999, pp. 15-1 - 15-12; In English; See also 19990040714; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

The Australian perspective of weapons/aircraft integration is presented in viewgraph form. The thrust of the presentation was to show the technical approach and organizational structure of how the Australians conduct the compatibility testing and clearance process. Their processes, their organizational structure, and philosophy is similar to that of the US. The Australians are now the only operators of the F-111 aircraft. They, like most other countries, have to work the integration issues of old and new aircraft and old and new weapons.
Derived from text
Military Aircraft; Weapons Delivery; Systems Integration; Weapon Systems; Systems Compatibility

19990040727 Naval Air Systems Command, Patuxent , MD USA
Weapon Systems Integration in Existing Aircraft
Reiber, Carl, Naval Air Systems Command, USA; Aircraft Weapon System Compatibility and Integration; April 1999, pp. 16-1 - 16-6; In English; See also 19990040714; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

This paper addresses the primary factors that allow the acquisition process to purchase an effective retrofit kit that meets evolving U.S. Navy's P-3 Fleet requirements, using my personal experiences in the weapon systems integration and modifcation of existing P-3C aircraft. These factors are analogous to any aircraft modification encompassing weapons integration. Contributing factors include procurement policies, analog versus digital interfaces, man-machine interface, and testing. The pros and cons associated with the use of non-military standards, COTS, or NDI in a cost-effective way will also be exemplifed using the P-3C Update III Block Modification Upgrade Program (BMUP) that the U.S. Navy's Maritime Surveillance Aircraft Program Office is executing.

Author

P-3 Aircraft; Weapon Systems; Systems Integration; Systems Compatibility; Performance Tests; Systems Simulation; Mathematical Models

19990040728 Army Aviation and Missile Command, Aviation Research, Development, and Engineering Center, Redstone Arsenal, AL USA

Rotary Wing Stores Integration (RWSI) Process

Obermark, J., Army Aviation and Missile Command, USA; Johnson, M., Army Aviation and Missile Command, USA; Aircraft Weapon System Compatibility and Integration; April 1999, pp. 18-1 - 18-6; In English; See also 19990040714; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

This paper gives an overview of the Rotary Wing Stores Integration (RWSI) process which has been developed to improve the current process of weapons integration with helicopters in the area of separation analysis. Several tools have been developed to implement this process. Their function and position within the process will be covered. Some background into the current process is provided. The current process is used to define the goals and requirements of the improved process. These requirements suggest the tools which are developed to implement the new process. The resultant tools are explained, along with their position and function within the new process. The verification and validation process of the tools is shown. The results and improvements which result from the new process are explained. Finally, the resultant process is analyzed to suggest improvements and tools for the future process.

Author

Rotary Wing Aircraft; External Store Separation; Weapon Systems; Systems Integration; Systems Compatibility; Computerized Simulation; Systems Engineering; Applications Programs (Computers); Mathematical Models

19990040729 Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Inst. fuer Flugmechanik, Brunswick, Germany

Helicopter/Weapon System Integration: An Overview and Synopsis of AGARD LS 209

Gmelin, Bernd L., Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; Aircraft Weapon System Compatibility and Integration; April 1999, pp. 19-1 - 19-10; In English; See also 19990040714; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

The helicopter is fast approaching a half century of service as a weapon system. From humble beginnings after World War II, largely in the roles of observation platforms and search and rescue vehicles, rotorcraft have evolved to a principal in the modern battle scenario. In the war at sea, the helicopter forms an integral part of a task force capable of launching devastating firepower at surface and subsurface targets. In the airland battle, technology has made the helicopter into a tank killer, troop transport and night observation platform. Finally, in the most unlikely arena, air-to-air combat, modern weaponry has shown the helicopter to be effective against even high performance tactical aircraft. Under ideal circumstances a new helicopter design is being directed towards certain weapon capabilities, making the weapon integration discipline a mature part of the design process. However, the rapid pace of weapons development often leads to airframe modification programs and weapons kits make high-technology weapons subsystems a part of older aircraft. In such cases, the system integration efforts is sometimes reduced to "cut-and-try". At best, such an approach may be inefficient at worst it may be unsafe. The AGARD Flight Vehicle integration Panel and the Consultant and Exchange Programme decided to set up in 1997 the Lecture Series 209 on Helicopter/Weapon System Integration. The Lecture Series considered the problems of integrating externally mounted weapons on helicopters with the focus on aeromechanical, structural and operational issues. New aspects in the field of helicopter/weapon system integration were addressed and strong emphasis was placed on the lessons learned from recent experiences in actual development programs. Case histories of weapons integration on the AH-64 Apache, the RAM-66 Comanche, the EH-101, and the Tiger were presented and discussed. This paper is intended to give an overview of the material provided in the lectures and to draw some essential conclusions from the discussions.

Author

Military Helicopters; Weapon Systems; Weapons Development; Systems Integration; Systems Compatibility; Aircraft Configurations

19990040730 Naval Air Warfare Center, Airframe, Ordnance, and Propulsion Div., China Lake, CA USA

Applications of Modern Multidisciplinary Approaches to the Integration of Weapons on Aircraft

Jeter, Edward L., Naval Air Warfare Center, USA; Aircraft Weapon System Compatibility and Integration; April 1999, pp. 20-1 - 20-14; In English; See also 19990040714; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

Modern computational methods are used extensively in the weapon integration process. These methods include, but are not limited to, computational fluid dynamics (CFD), three-dimensional solids modeling, finite element methods, linear and nonlinear structural mechanics, and multi-body dynamic systems analysis. While CFD methods are commonly used for aerodynamic predictions, the magnitude of numerical calculations associated with them often precludes their integration into multidisciplinary design environments. On the other hand, modern aerodynamic analysis procedures based on subsonic and supersonic panel methods are appropriate and have been incorporated into these environments. These procedures are called ”engineering methods,” and they have been combined with structural analyses, design, flight tests, and dynamic simulation to evaluate weapon/aircraft integration issues. An overview of this process is described and examples from actual weapons integration efforts are discussed. It is shown that these modern engineering methods are accurate and efficient, and can be utilized to complement procedures employed for weapons integration. Conclusions, lessons learned, and recommendations for future efforts are emphasized.

Author

Aircraft Configurations; Weapon Systems; Systems Integration; Systems Compatibility; Design Analysis; Multidisciplinary Design Optimization; Applications Programs (Computers)

19990040731 Dassault Aviation, Direction Generale Technique/Direction Technique Systeme, Saint-Cloud, France

How to Control the Cross Complexity of the Integration of Armament in a Combat Aircraft? *Comment Maitriser la Complexitie Croissante de l’Integration des Armements a un Avion de Combat?*

Chivot, Francois, Dassault Aviation, France; Aircraft Weapon System Compatibility and Integration; April 1999, pp. 21-1 - 21-10; In French; See also 19990040714; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

Since the middle of the 80’s, the integration of armaments to a carrier has become more and more complex, requiring an augmentation of cycles and costs supported finally by usage. This phenomenon has been particularly stressed in later years. The result of the integration of the number and nature of these interactions is due in part to the budgetary constraints of the other. In this context it is therefore necessary to perform evaluations for the actual process definition and development of the combination of ”aircraft plus armament”. Through the example of Air to Surface weapons, this paper proposes to present the evolution of the processes recommended by Dassault Aviation in view of controlling these cross complexities.

Transl. by CASI

Weapon Systems; Systems Integration; Systems Compatibility; Fighter Aircraft; Systems Management

19990040733 Daimler-Benz Aerospace A.G., Military Aircraft Div., Munich, Germany

Structural Deformation: A New Challenge to the Accuracy of Separation Codes

Deslandes, R., Daimler-Benz Aerospace A.G., Germany; Aircraft Weapon System Compatibility and Integration; April 1999, pp. 23-1 - 23-10; In English; See also 19990040714; Original contains color illustrations; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

In general, the state of the art analysis of the separation behaviour of an external store doesn’t consider the effects of local structural deformations of the carriage devices and launch equipment. Such deformations may be caused by steady/unsteady inertia and aerodynamic loads. The order of magnitude of such deformations ranges between tenths of degrees up to values of several units. If neglected within the prediction of separation behaviour, a consecutive flight test result normally comes up with a bad evidence. The intention of this paper is to demonstrate such adverse effects which are typical for fighter aircraft carrying external stores. A way ahead will indicate how to overcome these problems by implementing more accurately measured initial conditions into the postflight separation analysis. Thereby store trajectories computed with conventionally gathered initial conditions will be shown in comparison with conditions derived from inflight deformation measurements in order to underline the relevance of such corrections with respect to separation autopilot design and with respect to the clearance work.

Author

External Stores; External Store Separation; Fighter Aircraft; Elastic Deformation; Structural Analysis; Trajectory Analysis; Computerized Simulation; Applications Programs (Computers)

19990040734 Air Force Research Lab., Wright-Patterson AFB, OH USA

A Cooperative Response to Future Weapons Integration Needs

Grove, James E., Air Force Research Lab., USA; Pinney, Mark A., Air Force Research Lab., USA; Stanek, Michael J., Air Force Research Lab., USA; Aircraft Weapon System Compatibility and Integration; April 1999, pp. 24-1 - 24-12; In English; See also

19990040714; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

As military aircraft are designed for more complex and demanding missions, integrating weapons becomes an increasingly difficult task. to address the needs of the weapons integration community, in the face of shrinking defense budgets, Air Force Research Laboratory (AFRL) has initiated national/international cooperative efforts designed to address key integration issues. The efforts are focused in three areas; integrated design/analysis software and data management, active control of weapons bay environments, and low drag, survivable external carriage options.

Author

Systems Integration; Design Analysis; External Stores; External Store Separation; Computerized Simulation; Weapon Systems; Weapon System Management

19990040735 Matra BAe Dynamics, Velizy-Villacoublay, France

The Role of the Missileer in the Integration of a Tactical Missile to an Aircraft: The Example of Program 2000-5 ***Le Role du Missilier dans une Integration d'un Missile Tactique a un Aeronef: Exemple du Programme 2000-5***

Boischot, M., Matra BAe Dynamics, France; Aircraft Weapon System Compatibility and Integration; April 1999, pp. 25-1 - 25-6; In French; See also 19990040714; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

The complexity of modern armament systems, from the point of view of missiles requires an entire program for the adaptation of a missile to an aircraft, the increasing costs, and the so called separation of missile development. The Matra BAe Dynamics organization has generated a program of integration with a distinct team which is occupied with the development of missiles. We will see that to properly conduct such a program, the early participation of the missileer is necessary in the studies of the employment concept because he provides his knowledge of the missile and his experience with previous adaptations.

Transl. by CASI

Fighter Aircraft; Missile Systems; Systems Integration

19990040772 NASA Langley Research Center, Hampton, VA USA

Overview of Sensitivity Analysis and Shape Optimization for Complex Aerodynamic Configurations

Newman, James C., III, Mississippi State Univ., USA; Taylor, Arthur C., III, Old Dominion Univ., USA; Barnwell, Richard W., Virginia Univ., USA; Newman, Perry A., NASA Langley Research Center, USA; Hou, Gene J.-W., Old Dominion Univ., USA; Journal of Aircraft; January-February 1999; Volume 36, No. 1, pp. 87-96; In English

Contract(s)/Grant(s): NGT-51247; NAG1-1265; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

This paper presents a brief overview of some of the more recent advances in steady aerodynamic shape-design sensitivity analysis and optimization, based on advanced computational fluid dynamics (CFD). The focus here is on those methods particularly well-suited to the study of geometrically complex configurations and their potentially complex associated flow physics. When nonlinear state equations are considered in the optimization process, difficulties are found in the application of sensitivity analysis. Some techniques for circumventing such difficulties are currently being explored and are included here. Attention is directed to methods that utilize automatic differentiation to obtain aerodynamic sensitivity derivatives for both complex configurations and complex flow physics. Various examples of shape-design sensitivity analysis for unstructured-grid CFD algorithms are demonstrated for different formulations of the sensitivity equations. Finally, the use of advanced, unstructured-grid CFDs in multidisciplinary analyses and multidisciplinary sensitivity analyses within future optimization processes is recommended and encouraged.

Author

Research; Sensitivity; Shapes; Optimization; Aerodynamic Configurations; Design Analysis

19990040796 Geological Survey, Denver, CO USA

Unmanned Airborne Vehicle (UAV): Flight testing and evaluation of two-channel E-field Very Low Frequency (VLF) instrument

Dec. 31, 1998; 9p; In English

Report No.(s): DE99-001103; DOE/OR/22398-T1; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Using VLF frequencies, transmitted by the Navy's network, for airborne remote sensing of the earth's electrical, magnetic characteristics was first considered by the USA Geological Survey (USGS) around the mid 1970s. In the mid 1990s, the Branch of Geophysics designed and developed a two-channel E-field ground portable VLF system. The system was built using state-of-the-art circuit components and new concepts in circuit architecture. Small size, light weight, low power, durability, and reliability

were key considerations in the design of the instrument. The primary purpose of the instrument was for collecting VLF data during ground surveys over small grid areas.
NTIS
Measuring Instruments; Flight Tests; Evaluation; Data Acquisition; Pilotless Aircraft

19990040890 Defence Science and Technology Organisation, Maritime Platforms Div., Melbourne, Australia
Residual Stress Measurements and Boeing Wedge Durability Data for the Proposed 470 Bulkhead Bonded Repair
Olsson-Jacques, Christina, Defence Science and Technology Organisation, Australia; November 1998; In English
Report No.(s): DSTO-TN-0178; DODA-AR-010-675; Copyright; Avail: Issuing Activity (DSTO Aeronautical and Maritime Research Lab., PO Box 4331, Melbourne, Victoria 3001, Australia), Hardcopy, Microfiche

Fatigue cracking problems have occurred in the F/A-18 470.5 bulkhead during initial full scale testing. The surface of this bulkhead is shot-peened to introduce compressive residual stress to increase the fatigue life of the component as part of the manufacturing and maintenance program. The Aeronautical and Maritime Research Laboratory (AMRL) is investigating the effect of applying a composite patch to reduce the critical strains in the crotch area. Boeing wedge durability tests were used to define the most suitable metal preparation procedure to apply a durable patch to a shotpeened aluminum alloy surface. The x-ray diffraction technique was used to assess any reduction in the beneficial shot-peened residual stress after typical abrasion and heat treatment stages in the preparation procedure. It was found that the abrasion and heat treatment processes used to achieve the most durable surface treatment for bonding did not significantly reduce the beneficial compressive surface stresses induced by the shot-peening process.
Author
Residual Stress; Stress Measurement; Durability; Fatigue Life; Wedges

19990041098 Old Dominion Univ., Aerospace Engineering Dept., Norfolk, VA USA
Effect of Reduced Frequency on Super Maneuver Delta Wing
Abdelhamid, Yahia A., Old Dominion Univ., USA; Kandil, Osama A., Old Dominion Univ., USA; 1998; In English; 36th; Aerospace Sciences, 12-15 Jan. 1998, Reno, NV, USA
Contract(s)/Grant(s): NAG1-648
Report No.(s): AIAA Paper 98-0415; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

The unsteady, three-dimensional, Reynolds averaged Navier Stokes equations (NS) are used to simulate and study the flow response around a delta wing undergoing a pitch-up motion up to 90 degrees amplitude. The governing equations are solved time-accurately using the upwind. Roe flux-difference splitting, finite volume scheme. The primary model under consideration consists of a 76 degree swept, sharp-edged delta wing of zero thickness. The Reynolds number and Mach number are 0.45 X 10(exp 6) and .03 respectively. The wing is forced to pitch-up through a ramp function, using a wide range of reduced frequency to provide a good understanding of reduced frequency effect on high amplitude pitch maneuvers. Three reduced frequency values of .0834, 0.134 and 0.04, are used in this study. The computed results are compared with each other as well as the existing experimental data.
Author
Delta Wings; Navier-Stokes Equation; Reynolds Number; Pitch (Inclination); Ramp Functions; Finite Volume Method; Computational Fluid Dynamics; Baldwin-Lomax Turbulence Model; Grid Generation (Mathematics)

06
AIRCRAFT INSTRUMENTATION

Includes cockpit and cabin display devices; and flight instruments. For related information see also 19 Spacecraft Instrumentation and 35 Instrumentation and Photography.

19990040723 Naval Air Warfare Center, Aircraft Div., Patuxent River, MD USA
Development, Test and Integration of the AGM-114 Hellfire Missile System and FLIR/Laser on the H-60 Aircraft
Roberts, D., Naval Air Warfare Center, USA; Capezzuto, R., Naval Air Warfare Center, USA; Aircraft Weapon System Compatibility and Integration; April 1999, pp. 12-1 - 12-12; In English; See also 19990040714; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

The Hellfire Missile System (HMS) and a nose mounted FLIR with laser designator system were selected as integration candidates on H-60 derivatives based on a new fleet weapons requirement. Naval Air Warfare Center Aircraft Division (NAWCAD) Patuxent River conducted ground and flight tests to structurally qualify the HMS and FLIR systems and evaluate their integration

into the H-60 airframe. Three ground firings and 45 hours of flight test (including six missile firings and eight launcher jettisons) were conducted in 1995 during the technical feasibility phase and 60 test flight hours were flown in 1997 during the system integration phase. In-flight jettison and missile firing test planning utilized a six degree-of-freedom simulation to develop the minimum number of test points to clear the desired envelope while managing risk. Testing demonstrated the successful structural integration of the HMS and FLIR systems. Testing then proceeded with integration of the functional FLIR and HMS. The integration test program fired 6 missiles at fixed and moving targets, under day and night conditions over land and water using the FLIR/LASER for tracking and autonomous designation. Integration development and testing utilized specialized U.S. Army Hellfire instrumentation as well as the Laser Designator Weapons System Simulator (LDWSS) modeling tool. LDWSS was used to simulate launch conditions and engagement scenarios, predict missile launch transients and trajectories, and identify launch constraint and laser self-designation issues. The simulation tools and test methods employed minimized test flights and required assets, resulting in an efficient certification of this weapon system for fleet use.
Author
H-60 Helicopter; Missile Systems; Systems Integration; Weapons Delivery; Flight Tests; Ballistic Trajectories; Ground Tests; Systems Compatibility; Computerized Simulation; External Store Separation

07
AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and onboard auxiliary power plants for aircraft. For related information see also 20 Spacecraft Propulsion and Power, 28 Propellants and Fuels, and 44 Energy Production and Conversion.

19990040175 Environmental Quality Management, Inc., Cincinnati, OH USA
Aircraft Engine and Auxiliary Power Unit Emissions Testing, Volume 3, Particulate Matter Results ***Final Report***
Gerstle, Thomas, Environmental Quality Management, Inc., USA; Virage, Peter, Weston (Roy F.), Inc., USA; Wade, Mark, Department of the Air Force, USA; Kimm, Larry, Department of the Air Force, USA; March 1999; 220p; In English
Contract(s)/Grant(s): F41624-95-D-9019
Report No.(s): AD-A361473; IERA-RS-BR-TR-1999-0006-V-3; No Copyright; Avail: CASI; A10, Hardcopy; A03, Microfiche
This report is the product of a 2-year emissions testing program designed to document, characterize, and evaluate emissions from sixteen aircraft engines, two helicopter engines, and two auxiliary power units (APUs) burning JP-8 fuel. The purpose of this engine testing program was to develop emission factors for the tested engines under representative engine load conditions. All testing was performed by the Environmental Quality Management Inc. (EQ) and Roy F. Weston, Inc. (Weston) team. Testing was conducted for criteria pollutants and select hazardous air pollutants (HAPs), e.g., aldehyde/ketones and semi volatile and volatile organic compounds.
DTIC
Aircraft Engines; Helicopter Engines; Exhaust Emission; Environmental Quality; Engine Tests; Combustion

19990040176 Environmental Quality Management, Inc., Cincinnati, OH USA
Aircraft Engine and Auxiliary Power Unit Emissions Testing, Volume 1, Executive Summary ***Final Report***
Gerstle, Thomas, Environmental Quality Management, Inc., USA; Virage, Peter, Weston (Roy F.), Inc., USA; Wade, Mark, Department of the Air Force, USA; Kimm, Larry, Department of the Air Force, USA; March 1999; 56p; In English
Contract(s)/Grant(s): F41624-95-D-9019
Report No.(s): AD-A361474; IERA-RS-BR-TR-1999-0006-V-1; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche
This report is the product of a 2-year emissions testing program designed to document, characterize, and evaluate emissions from sixteen aircraft engines, two helicopter engines, and two auxiliary power units (APUs) burning JP-8 fuel. The purpose of this engine testing program was to develop emission factors for the tested engines under representative engine load conditions. All testing was performed by the Environmental Quality Management Inc. (EQ) and Roy F. Weston, Inc. (Weston) team. Testing was conducted for criteria pollutants and select hazardous air pollutants (HAPs), e.g., aldehyde/ketones and semivolatile and volatile organic compounds.
DTIC
Aircraft Engines; Environmental Quality; Exhaust Emission; Engine Tests; Emission

19990040177 Environmental Quality Management, Inc., Cincinnati, OH USA

Aircraft Engine and Auxiliary Power Unit Emissions Testing,, Volume 2, Detailed Sampling Approach and Results ***Final Report***

Gerstle, Thomas, Environmental Quality Management, Inc., USA; Virage, Peter, Weston (Roy F.), Inc., USA; Wade, Mark, Department of the Air Force, USA; Kimm, Larry, Department of the Air Force, USA; March 1999; 1384p; In English

Contract(s)/Grant(s): F41624-95-D-9019

Report No.(s): AD-A361475; IERA-RS-BR-TR-1999-0006-V-2; No Copyright; Avail: CASI; A99, Hardcopy; A10, Microfiche

This report is the product of a 2-year emissions testing program designed to document, characterize, and evaluate emissions from sixteen aircraft engines, two helicopter engines, and two auxiliary power units (APUs) burning JP-8 fuel. The purpose of this engine testing program was to develop emission factors for the tested engines under representative engine load conditions. All testing was performed by the Environmental Quality Management Inc. (EQ) and Roy F. Weston, Inc. (Weston) team. Testing was conducted for criteria pollutants and select hazardous air pollutants (HAPs), e.g., aldehyde/ketones and semi- volatile and volatile organic compounds.

DTIC

Aircraft Engines; Exhaust Emission; Design Analysis; Environmental Quality; Air Pollution

19990040657 NASA Glenn Research Center, Cleveland, OH USA

Real-Time Optical Fuel-to-Air Ratio Sensor for Gas Turbine Combustors

Nguyen, Quang-Viet, NASA Glenn Research Center, USA; Mongia, Rajiv K., California Univ., USA; Dibble, Robert W., California Univ., USA; March 1999; 10p; In English

Contract(s)/Grant(s): RTOP 523-36-13

Report No.(s): NASA/TM-1999-209041; NAS 1.15:209041; E-11566; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The measurement of the temporal distribution of fuel in gas turbine combustors is important in considering pollution, combustion efficiency and combustor dynamics and acoustics. Much of the previous work in measuring fuel distributions in gas turbine combustors has focused on the spatial aspect of the distribution. The temporal aspect however, has often been overlooked, even though it is just as important. In part, this is due to the challenges of applying real-time diagnostic techniques in a high pressure and high temperature environment. A simple and low-cost instrument that non-intrusively measures the real-time fuel-to-air ratio (FAR) in a gas turbine combustor has been developed. The device uses a dual wavelength laser absorption technique to measure the concentration of most hydrocarbon fuels such as jet fuel, methane, propane, etc. The device can be configured to use fiber optics to measure the local FAR inside a high pressure test rig without the need for windows. Alternatively, the device can readily be used in test rigs that have existing windows without modifications. An initial application of this instrument was to obtain time-resolved measurements of the FAR in the premixer of a lean premixed prevaporized (LPP) combustor at inlet air pressures and temperatures as high as 17 atm at 800 K, with liquid JP-8 as the fuel. Results will be presented that quantitatively show the transient nature of the local FAR inside a LPP gas turbine combustor at actual operating conditions. The high speed (kHz) time resolution of this device, combined with a rugged fiber optic delivery system, should enable the realization of a flight capable active-feedback and control system for the abatement of noise and pollutant emissions in the future. Other applications that require an in-situ and time-resolved measurement of fuel vapor concentrations should also find this device to be of use.

Author

Real Time Operation; Optical Equipment; Fuel-Air Ratio; Gas Turbines; Combustion Chambers; Active Control; Exhaust Emission

19990040966 Defence Science and Technology Organisation, Aeronautical and Maritime Research Lab., Fishermens Bend, Australia

Simulation and Modelling of Reacting Particles Relevant to Gas Turbine Engine Combustion

Smith, Nigel S. A., Defence Science and Technology Organisation, Australia; December 1998; In English

Report No.(s): DSTO-RR-0142; DODA-AR-010-688; Copyright; Avail: Issuing Activity (DSTO, Aeronautical and Maritime Research Lab., 506 Lorimer St., Fishermens Bend, Victoria, Australia 3207), Hardcopy, Microfiche

A conditional moment closure model is proposed for reacting particles in turbulent nonpremixed combustion. The new model for particles differs significantly from the traditional uniform diffusivity gas-phase conditional moment closure model. The new

features of the model and model effectiveness are examined against direct numerical simulation data for soot-like and droplet-like particles in turbulent nonpremixed combustion. The influence of differing particle sizes, types, and reactivity on the effectiveness of the model closure is examined in detail.
Author
Models; Direct Numerical Simulation; Reactivity; Drops (Liquids); Soot

19990041065 NASA Lewis Research Center, Cleveland, OH USA
H(sub infinity) Control Design for a Jet Engine
Adibhatla, Shrider, General Electric Co., USA; Garg, Sanjay, NASA Lewis Research Center, USA; Collier, George J., General Electric Co., USA; Zhao, Xin, General Electric Co., USA; 1998; In English; Propulsion, 12-15 Jul. 1998, Cleveland, OH, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Report No.(s): AIAA Paper 98-3753; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

This paper deals with the application of advanced multivariable control technologies to jet engines. These technologies include a modified H(sub infinity) technique, techniques for reducing the order of the controller, a simplified gain scheduling technique, and an integrator windup protection scheme. Application of these techniques to a variable cycle engine is described. A graphical user that simplified the design and code maintenance process was used for all the design work. Results of evaluation using linear and nonlinear models are summarized. A new order reduction technique is presented. The impact of unintended differences in the design and test models is explained. The techniques used all worked well, except for the integrator windup scheme, which needs further work.
Author
Jet Engines; Variable Cycle Engines; Multivariable Control

08
AIRCRAFT STABILITY AND CONTROL

Includes aircraft handling qualities; piloting; flight controls; and autopilots. For related information see also 05 Aircraft Design, Testing and Performance.

19990040770 Old Dominion Univ., Aerospace Engineering Dept., Norfolk, VA USA
Coupled and Uncoupled Bending-Torsion Responses of Twin-Tail Buffet
Kandil, O. A., Old Dominion Univ., USA; Sheta, E. F., Old Dominion Univ., USA; Journal of Fluids and Structures; 1998; ISSN 0889-9746; Volume 12, Article f1980168, pp. 677-701; In English
Contract(s)/Grant(s): NAG1-648; NAG1-994; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

The effect of coupled and uncoupled bending and torsion modes on flexible twin-tail buffet is considered, This multidisciplinary problem is investigated using three sets of equations on a multi-block grid structure. The first set is the unsteady, compressible, laminar full Navier-Stokes equations which are used for obtaining the flow-filed vector and the aerodynamic loads on the twin tails. The second set is the coupled aeroelastic equations which are used for obtaining the bending and torsional deflections of the twin tails. The third set is the grid-displacement equations which are used for updating the grid coordinates due to the tail deflections. The configuration is pitched at 30 deg. angle of attack and the free-stream Mach number and Reynolds number are 0.3 and 1-25 million, respectively. Keeping the twin tails as rigid surfaces, the problem is solved for the initial flow conditions. Next, the problem is solved for the flexible twin-tail responses due to the unsteady loads produced by the vortex breakdown flow of the delta-wing leading-edge vortex cores. The configuration is investigated for the effect of coupled and uncoupled bending and torsion modes, using two different separation distances of the twin-tail; the inboard and the outboard positions. The computational results are in good with the experimental data.
Author
Buffeting; Couplers; Bending; Torsion; Tail Assemblies; Uncoupled Modes; Loads (Forces); Delta Wings; Aeroelasticity

09
RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, hangars and runways; aircraft repair and overhaul facilities; wind tunnels; shock tubes; and aircraft engine test stands. For related information see also 14 Ground Support Systems and Facilities (Space).

19990039565 Raytheon Training and Services Co., Mesa, AZ USA
M2DART: A Real-Image Simulator Visual Display System ***Final Report, Jul. 1997 - Sep. 1998***
Wight, Donal R.; Best, Leonard G.; Peppler, Philipp W.; Nov. 1998; 16p; In English
Contract(s)/Grant(s): F41624-97-D-5000; AF Proj. 2743
Report No.(s): AD-A361265; AFRL-HE-AZ-TR-1998-0097; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report describes the Mobile Modular Display for Advanced Research and Training (M2DART) that was designed and fabricated at the Air Force Research Laboratory's Warfighter Training Research Division in Mesa, Arizona. The M2DART is an eight-channel, state-of-the-art, real-image, rear-projection, visual display system. It is a full-color, high-resolution, wraparound display system designed for use with single-seat cockpit simulators. This report provides a system description, which includes hardware configuration, screen geometry, field of view, spatial resolution, luminance, and contrast values.
DTIC
Flight Simulators; Display Devices; Design Analysis; Fabrication

19990040337 NASA Marshall Space Flight Center, Huntsville, AL USA
An Overview of the Electrostatic Levitation Facility at NASA's Marshall Space Flight Center
Rogers, Jan R., NASA Marshall Space Flight Center, USA; Robinson, Michael B., NASA Marshall Space Flight Center, USA; Savage, Larry, NASA Marshall Space Flight Center, USA; Soellner, Wolfgang, Raytheon Co., USA; Huie, Doug, Mevatec Corp., USA; NASA Microgravity Materials Science Conference; February 1999, pp. 561; In English; See also 19990040241; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche; Abstract Only; Abstract Only

Containerless processing represents an important area of research in microgravity materials science. This method provides access to the metastable state of an undercooled melt. Containerless processing provides a high-purity environment for the study of reactive, high-temperature materials. Reduced gravity affords several benefits for containerless processing; for example, greatly reduced positioning forces are required and therefore samples of greater mass can be studied. Additionally, in reduced gravity larger specimens will maintain spherical shape which will facilitate modeling efforts. Space Systems/LORAL developed an Electrostatic Containerless Processing System (ESCAPES) as a materials science research tool for investigations of refractory solids and melts. ESCAPES is designed for the investigation of thermophysical properties, phase equilibria, metastable phase formation, undercooling and nucleation, time-temperature-transformation diagrams, and other aspects of materials processing. These capabilities are critical to the research programs of several Principal Investigators supported by the Microgravity Materials Science Program of NASA. NASA's Marshall Space Flight Center (MSFC) recently acquired the ESCAPES system from LORAL. MSFC is now developing a levitation facility in order to provide a critical resource to the microgravity materials science research community and to continue and enhance ground-based research in the support of the development of flight experiments during the transition to Space Station.
Derived from text
Test Facilities; Levitation; Electrostatics; Microgravity

19990040402 Biodynamic Research Corp., San Antonio, TX USA
Model Validation and Design for the Dynamic Environment Simulator. Phase 2 ***Final Report, May 1996 - Sep. 1998***
van Poppel, Jon A.; Pancratz, David J.; Rangel, Mike H.; Barton, Brian J.; Banks, Robert D.; Sep. 1998; 131p; In English
Contract(s)/Grant(s): F41624-96-C-6027
Report No.(s): AD-A361235; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

This report describes all SBIR Phase 2 effort to validate a mathematical model mid conduct a design study of the Air Force Dynamic Environment Simulator. The Dynamic Environment Simulator, or DES, is a three degree-of-freedom centrifuge operated by Armstrong Laboratories at Wright-Patterson AFB. The effort was conducted under Contract F41624-96-C-6027 through the Armstrong Laboratory and was entitled "Model Validation and Design Study of the Dynamic Environment Simulator." This Phase 2 project had four primary objectives, which were to: (1) Validate the Phase 1 software model of the DES; (2) Conduct a design study of DES improvements; (3) Perform a cost/benefit analysis of the possible DES improvements; and (4) Demonstrate the commercial potential of the model and the DES.
DTIC
Software Engineering; Mathematical Models; Degrees of Freedom; Computer Program Integrity

19990040651 Army Construction Engineering Research Lab., Champaign, IL USA
Case Study: Structural Evaluation of Steel Truss Aircraft Hangars at Corpus Christi Army Depot, Texas ***Final Report***
Al-Chaar, Ghassan K.; Ericksen, Jason; Desai, Pramod; Feb. 1999; 723p; In English
Report No.(s): AD-A361006; CERL-TR-99/27; No Copyright; Avail: CASI; A99, Hardcopy; A06, Microfiche

A number of steel truss aircraft hangars at Corpus Christ Army Depot (CCAD) are similar to those that have performed poorly during recent hurricanes in other parts of the country. Engineering analysis of such structures currently in use can identify structural vulnerabilities, and retrofit schemes may be developed to reduce or eliminate these vulnerabilities to severe wind loads. The objective of this work was to evaluate the structural adequacy of four steel truss aircraft hangars at CCAD by conducting structural analyses using the most recent building code guidelines. State-of-the-art data on the behavior of steel structures under dynamic loads were utilized. The current conditions of CCAD aircraft hangars 43, 44, 45, and 47 were evaluated. Structural deficiencies and overstressed members and joints were identified, and retrofit methods to meet the requirements of current codes were developed. Exhaustive data from the engineering analyses are included, and specific recommendations for retrofit are presented.
DTIC
Hangars; Steel Structures; Structural Analysis; Trusses

12
ASTRONAUTICS (GENERAL)

For extraterrestrial exploration see 91 Lunar and Planetary Exploration.

19990039099 Naval Space Command, Dahlgren, VA USA
Naval Space Command, Space Tracks: A Bulletin on Naval Space Issues and Initiatives, March/April 1999
Apr. 1999; 20p; In English
Report No.(s): AD-A361415; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Space Tracks is published five times a year as an official, authorized publication of Naval Space Command. Its purpose is to discuss naval space issues and initiatives, and promote a broader awareness of space support available to the naval warfighter. This issue concerns naval perspectives of space, sea launches, navy satellites, measurement of space radiation by navy payloads, SATCOM course, and space billets.
DTIC
Artificial Satellites; Spacecraft Launching; Payloads; Communication Satellites; Aerospace Sciences

19990040409 Central Research Inst. of Machine Building, Korolev, Russia
1st International Conference on Small Satellites: New Technologies, Achievements, Problems and Prospects for International Co-Operation in the New Millenium
Jan. 1998; 630p; In English; In Russian; 1st, 16-20 Nov. 1998, Korolyov, Russia
Report No.(s): AD-A361187; EOARD-CSP-99-5002-2; No Copyright; Avail: CASI; A99, Hardcopy; A06, Microfiche

The Final Proceedings for Small Satellites: New technologies, achievements, problems and prospects for international co-operation in the new millenium, 16 November 1998 - 20 November 1998 This is an interdisciplinary conference. Topics include space technology, satellite engineering and space applications.
DTIC
Small Scientific Satellites; Small Satellite Technology; Satellite Design

14
GROUND SUPPORT SYSTEMS AND FACILITIES (SPAC

19990040224 CSA Engineering, Inc., Engineering Services in Structural Dynamics, Palo Alto, CA USA
Analysis and Test Support for Phillips Laboratory Precision Structures
Goodding, James, CSA Engineering, Inc., USA; November 1998; 20p; In English
Contract(s)/Grant(s): F33615-94-C-3200
Report No.(s): AD-A361477; CSA-98-11-02; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report documents work performed for the Aerospace Structures Information and Analysis Center (ASIAC) under ASIAC Task 35, ”Analysis and Test support for Phillips Laboratory Precision Structures.” Mr. James Goodding of CSA Engineering was the principal investigator for this task. Mr. Goodding is an integral team member on a number of experiments at the Air

Force Research Laboratory (AFRL), Phillips Research Site. Task objectives centered around analysis and structural dynamic test support on experiments within the Space Vehicles Directorate at Kirtland Air Force Base. These efforts help to augment the Air Force's understanding of advanced technology devices and interactions with aerospace structures. One of the programs supported in this task was the Vibration Isolation and Suppression System (VISS), an AFRL experiment that will fly as part of the Space Technology Research Vehicle-2 (STRV-2) mission. VISS will demonstrate state-of- the-art vibration mitigation technologies for a satellite-based observation platform. Activities included environmental flight qualification test support and participation in the performance test program. The performance testing characterized both open and closed-loop dynamics used to implement the control laws. The Satellite Ultraquiet Isolation Technology Experiment (SUITE) is another AFRL experiment with many of the same objectives as VISS. Efforts in Task 35 included hardware and software development of the sophisticated active system experiment. Additional efforts included flight hardware acceptance test support for vibration and thermal/vacuum environments prior to delivery to Surrey Satellite Technology Limited (SSTL) for spacecraft integration. Assistance to the UltraLITE program was included in this effort. UltraLiTE will demonstrate the capability to control deployable space structures to nanometer accuracy in the laboratory.
DTIC
Vibration Isolators; Aircraft Structures; Dynamic Tests; Feedback Control; Performance Tests; Aerospace Engineering; Observation; Isolation

19990040474 Pittsburgh-Des Moines Steel Co., Pittsburgh, PA USA
A New Thermal Vacuum Facility for Hughes Space and Communications at El Segundo, California
Watson, Robert N., Pittsburgh-Des Moines Steel Co., USA; Proulx, Gregory F., Hughes Space and Communications Group, USA; 20th Space Simulation Conference: The Changing Testing Paradigm; February 1999, pp. 113-129; In English; See also 19990040464; No Copyright; Avail: CASI; A03, Hardcopy; A03, Microfiche

A new thermal vacuum test facility has been recently completed at the Hughes Space and Communications Company in El Segundo, California. The facility was designed, fabricated, installed and tested as a turn-key project by Pitt-Des Moines Inc. The chamber has a 12.19 meters by 14.48 meters (40 feet by 47 feet, 6 inches) flat floor and a half-cylindrical roof with a diameter of 12.19 meters (40 feet). One end of the chamber has a full cross section door, equipped with a translating motor for horizontal motion. The chamber is provided with six 1.89 meters (48 inches) cryopumps to obtain an ultimate pressure of 3 x 1 0(exp -7) Torr (Clean-Dry-Empty). The thermal shroud is designed to operate at a maximum of - 179 C (-290 F) with an internal heat input of 300 kW using liquid nitrogen. The shroud is also designed to operate at any temperature between -156 C (-250 F) and 121 C (+250 F) using gaseous nitrogen, and heat or cool at a rate of 1.1 C (2 F) per minute. A removable internal liquid nitrogen panel allows the test envelope to be subdivided to support test of two items simultaneously.
Author
Liquid Nitrogen; Shrouds; Test Facilities; Thermal Vacuum Tests; Cryogenic Cooling; Vacuum Chambers; Nitrogen

19990040488 Air Force Research Lab., Propulsion Directorate, Edwards AFB, CA USA
A High Altitude Space Simulation Facility to Study Exhaust Plume Interactions and Contamination
Ketsdever, Andrew D., Air Force Research Lab., USA; Lutfy, Fred M., University of Southern California, USA; Vargo, Stephen E., University of Southern California, USA; Muntz, E. P., University of Southern California, USA; 20th Space Simulation Conference: The Changing Testing Paradigm; February 1999, pp. 285-301; In English; See also 19990040464; No Copyright; Avail: CASI; A03, Hardcopy; A03, Microfiche

Interest in realistic simulation of the space environment as applied to the study of spacecraft contamination and thruster plumes has led to the development of the CHAFF-4 facility. CHAFF-4 uses a multi-fin cryogenically cooled army (about 20K) that completely envelops the interior of the chamber providing an available condensing surface area of 590 Square Meters. The geometry of the array capitalizes on the fact that both neutral and ion species from spacecraft propulsion systems predominantly undergo diffuse reflections when impacting at angles normal to the surfaces they encounter. Preliminary figures of merit for the equivalent altitude possible for various propulsion systems vary between 150-350]am (depending on thruster type). The effective pumping speed is predicted to be between 3x10(exp 7)and 1x10(exp 8) liters/sec. The facility is expected to accommodate thruster power levels up to 3500 W without the use of supplementary liquid helium, although infrastructure permitting its use is available. Developmental considerations and design issues are discussed in view of basic principles of plume testing and contamination, in order to ensure the integrity of phenomena that are observed in the facility. Provisions for the simulation of high-speed LEO flow environments have been incorporated in the design, and the corresponding pumping requirements are well within the capabilities of CHAFF-4.
Author
Aerospace Environments; Plumes; Simulation; Spacecraft Contamination; Spacecraft Propulsion; Test Facilities; Low Earth Orbits

19990040489 Construcciones Aeronauticas S.A., Space Div., Madrid, Spain

Portable Microvibration Test Facility for Spacecrafts

Martin, Gabriel, Construcciones Aeronauticas S.A., Spain; 20th Space Simulation Conference: The Changing Testing Paradigm; February 1999, pp. 303-310; In English; See also 19990040464; No Copyright; Avail: CASI; A02, Hardcopy; A03, Microfiche

A new microvibration test facility is described. This test facility has been developed in C.A.S.A. Space Division in Madrid (Spain) and is used for microvibration tests of specimens as large as 2x2x4.5 m (6.5x6.5x14.7 ft). The facility is portable and can be used in any place with a minimum environmental conditions, needing two weeks of installation time and only mains and air-pressure supply (6 bar or 87 psi) for the facility to run. One acoustic cabin is used for acoustic noise screening while an air-mounts system filters the groundfloor noise, acting as off-loading system at the same time. Specimens of 1500 kg (3300 lb) weight have been tested with good results, not being 1500 kg the weight of the heaviest specimen that can be tested. We have measured accelerometer background noise (including all the measurement chain) of 10(exp -6) ms(exp -2) (10(exp -7) g' s) during test inside a standard clean room with large specimens and force sensors background noise during test of 10(exp -5) N. The paper describes in detail the facility, the type of measurements, excitation capabilities, previous measurements to qualify the site where the facility is going to be installed, type of inputs, suspension system features and the instrumentation.

Author

Clean Rooms; Test Facilities; Vibration Simulators; Portable Equipment

19990040490 Dayton Univ. Research Inst., OH USA

The US Air Force Research Laboratory's Newly Upgraded SCEPTRE Facility

Cerbus, Clifford A., Dayton Univ. Research Inst., USA; 20th Space Simulation Conference: The Changing Testing Paradigm; February 1999, pp. 311-317; In English; See also 19990040464; No Copyright; Avail: CASI; A02, Hardcopy; A03, Microfiche

The US Air Force Research Laboratory Materials & Manufacturing Directorate has maintained some form of space simulation facility designed to expose thermal control materials to a simulated space environment for over 35 years. During that time the University of Dayton Research Institute (UDRI) has participated in these research efforts and is currently responsible for the operation of the facility which is known as the SCEPTRE (Space Combined Effects Primary Research and Test Equipment) Facility. In its previous configuration the SCEPTRE Facility simultaneously exposed thermal control materials to a combined vacuum, UV, and electron environment while monitoring the materials solar absorptance in vacuo. Over the years the facility's limitations had become increasingly unacceptable and a new configuration has been designed and assembled to overcome many of these shortcomings. The new system consists of a larger vacuum chamber with a two stage specimen load-lock system for both individual and group specimen introduction to the main chamber. The new design also incorporates the addition of a 50 KeV proton gun, a new solar simulator, and increased specimen throughput. This paper will present a brief history of the facility along with its previous capabilities and a complete description of the upgraded design and its enhanced capabilities. Currently, construction of the new system has been completed and some initial testing has been completed to verify its performance.

Author

Aerospace Environments; Far Ultraviolet Radiation; Solar Energy Absorbers; Solar Simulators; Vacuum Chambers; Space Simulators; Test Facilities; Protons

19990040491 NASA Goddard Space Flight Center, Greenbelt, MD USA

Refurbishment and Automation of Thermal Vacuum Facilities at NASA/GSFC

Dunn, Jamie, NASA Goddard Space Flight Center, USA; Gomez, Carlos, NASA Goddard Space Flight Center, USA; Donohue, John, NASA Goddard Space Flight Center, USA; Johnson, Chris, ManTech Systems Engineering Corp., USA; Palmer, John, ManTech Systems Engineering Corp., USA; Sushon, Janet, ManTech Systems Engineering Corp., USA; 20th Space Simulation Conference: The Changing Testing Paradigm; February 1999, pp. 319-322; In English; See also 19990040464; No Copyright; Avail: CASI; A01, Hardcopy; A03, Microfiche

The thermal vacuum facilities located at the Goddard Space Flight Center (GSFC) have supported both manned and unmanned space flight since the 1960s. Of the eleven facilities, currently ten of the systems are scheduled for refurbishment or replacement as part of a five-year implementation. Expected return on investment includes the reduction in test schedules, improvements in safety of facility operations, and reduction in the personnel support required for a test. Additionally, GSFC will become a global resource renowned for expertise in thermal engineering, mechanical engineering, and for the automation of thermal vacuum facilities and tests. Automation of the thermal vacuum facilities includes the utilization of Programmable Logic Controllers (PLCs), the use of Supervisory Control and Data Acquisition (SCADA) systems, and the development of a centralized Test Data Management System. These components allow the computer control and automation of mechanical components such

as valves and pumps. The project of refurbishment and automation began in 1996 and has resulted in complete computer control of one facility (Facility 281), and the integration of electronically controlled devices and PLCs in multiple others.
Author
Replacing; Thermal Vacuum Tests; Vacuum Chambers; Test Facilities; Automatic Control

15
LAUNCH VEHICLES AND SPACE VEHICLES

Includes boosters; operating problems of launch/space vehicle systems; and reusable vehicles. For related information see also 20 Spacecraft Propulsion and Power.

19990040544 NASA Marshall Space Flight Center, Huntsville, AL USA
Reusable Launch Vehicle (RLV) Market Analysis Model
Prince, Frank A., NASA Marshall Space Flight Center, USA; [1999]; 11p; In English; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The RLV Market Analysis model is at best a rough order approximation of actual market behavior. However, it does give a quick indication if the flights exists to enable an economically viable RLV, and the assumptions necessary for the vehicle to capture those flights. Additional analysis, market research, and updating with the latest information on payloads and launches would improve the model. Plans are to update the model as new information becomes available and new requirements are levied. This tool will continue to be a vital part of NASA's RLV business analysis capability for the foreseeable future.
Derived from text
Commerce; Market Research; Reusable Launch Vehicles; Industries; Models; Space Commercialization; Government/Industry Relations; Commercial Spacecraft; Spacecraft Launching

16
SPACE TRANSPORTATION

Includes passenger and cargo space transportation, e.g., shuttle operations; and space rescue techniques. for related information see also 03 Air Transportation and Safety and 18 Spacecraft Design, Testing and Performance. For space suits see 54 Man/System Technology and Life Support

19990040773 NASA Langley Research Center, Hampton, VA USA
Multidisciplinary Conceptual Design Optimization of Space Transportation Systems
Rowell, Lawrence F., NASA Langley Research Center, USA; Braun, Robert D., NASA Langley Research Center, USA; Olds, John R., Georgia Inst. of Tech., USA; Unal, Resit, Old Dominion Univ., USA; Journal of Aircraft; January-February 1999; Volume 36, No. 1, pp. 218-226; In English; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

This paper presents a recent history of progress both in disciplinary modeling and in optimization methods and frameworks for space transportation systems conceptual design and analysis. The disciplinary models and process typically used for space transportation analyses are identified, including physics-based and empirical models. The diverse characteristics of these disciplinary models require equally diverse integration and optimization approaches to enable implementation of automated, multidisciplinary design systems. Two general approaches are described for integrating these disciplinary models into computational frameworks for automated vehicle synthesis and optimization. Several optimization approaches are discussed including parameter, gradient-based, stochastic, and collaborative methods. Representative examples are given of multidisciplinary applications of optimization methods to the launch vehicle conceptual design problem. A primary goal for the future is to enable a space transportation design-to-cost capability.
Author
Space Transportation System; Multidisciplinary Design Optimization; Models; Design Analysis

17
SPACE COMMUNICATIONS, SPACECRAFT COMMUNICATIONS, COMMAND AND TRACKING

Includes telemetry; space communications networks; astronavigation and guidance; and radio blackout. For related information see also 04 Aircraft Communications and Navigation and 32 Communications and Radar.

19990039167 GenCorp Aerojet, Azusa, CA USA
Integrated Advanced Microwave Sounding Unit-A(AMSU-A). Engineering Test Report: METSAT A1 Signal Processor, (P/N 1331670-2, S /N F05)
Lund, D., GenCorp Aerojet, USA; Oct. 28, 1998; 29p; In English
Contract(s)/Grant(s): NAS5-32314
Report No.(s): NASA/CR-1998-209211; NAS 1.26:209211; AEROJET-11303; CDRL-207; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report presents a description of the tests performed, and the test data, for the AI METSAT Signal Processor Assembly P/N 1331670-2, S/N F05. The assembly was tested in accordance with AE-26754, "METSAT Signal Processor Scan Drive and Integration Procedure." The objective is to demonstrate functionality of the signal processor prior to instrument integration. Author

Performance Tests; Advanced Microwave Sounding Unit; Functional Analysis

19990039654 Aerojet-General Corp., Azusa, CA USA
Integrated Advanced Microwave Sounding Unit-A (AMSU-A). Engineering Test Report: METSAT A1 Signal Processor (P/N: 1331670-2, S/N: F04)
Lund, D., Aerojet-General Corp., USA; Dec. 07, 1998; 38p; In English
Contract(s)/Grant(s): NAS5-32314
Report No.(s): NASA/CR-1998-209222; NAS 1.26:209222; AEROJET-11357; CDRL-207; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report presents a description of the tests performed, and the test data, for the A1 METSAT Signal Processor Assembly PN: 1331679-2, S/N F04. The assembly was tested in accordance with AE-26754, "METSAT Signal Processor Scan Drive Test and Integration Procedure." The objective is to demonstrate functionality of the signal processor prior to instrument integration. Author

Advanced Microwave Sounding Unit; Signal Analyzers; Signal Processing; Documentation; Tests; Acceptability; Checkout

18
SPACECRAFT DESIGN, TESTING AND PERFORMANCE

Includes satellites; space platforms; space stations; spacecraft systems and components such as thermal and environmental controls; and attitude controls. For life support systems see 54 Man/System Technology and Life Support. For related information see also 05 Aircraft Design, Testing and Performance, 39 Structural Mechanics, and 16 Space Transportation.

19990039118 Computer Sciences Corp., Lanham, MD USA
Submillimeter Wave Astronomy Satellite (SWAS) Launch and Early Orbit Support Experiences
Kirschner, S., Computer Sciences Corp., USA; Sedlak, J., Computer Sciences Corp., USA; Challa, M., Computer Sciences Corp., USA; Nicholson, A., Computer Sciences Corp., USA; Sande, C., Computer Sciences Corp., USA; Rohrbaugh, D., Computer Sciences Corp., USA; 1999; 15p; In English; Flight Mechanics, May 1999, Greenbelt, MD, USA
Contract(s)/Grant(s): NAS5-31000; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The Submillimeter Wave Astronomy Satellite (SWAS) was successfully launched on December 6, 1998 at 00:58 UTC. The two year mission is the fourth in the series of Small Explorer (SMEX) missions. SWAS is dedicated to the study of star formation and interstellar chemistry. SWAS was injected into a 635 km by 650 km orbit with an inclination of nearly 70 deg by an Orbital Sciences Corporation Pegasus XL launch vehicle. The Flight Dynamics attitude and navigation teams supported all phases of the early mission. This support included orbit determination, attitude determination, real-time monitoring, and sensor calibration. This paper reports the main results and lessons learned concerning navigation, support software, star tracker performance, magnetometer and gyroscope calibrations, and anomaly resolution. This includes information on spacecraft tip-off rates, first-day nav-

igation problems, target acquisition anomalies, star tracker anomalies, and significant sensor improvements due to calibration efforts.
Author
Submillimeter Waves; Star Formation; Interstellar Chemistry; Orbit Calculation; Navigation

19990039169 NASA Goddard Space Flight Center, Greenbelt, MD USA
Spacecraft Potential Control by the Plasma Source Instrument on the POLAR Satellite
Comfort, R. H., Alabama Univ., USA; Moore, T. E., NASA Goddard Space Flight Center, USA; Craven, P. D., NASA Marshall Space Flight Center, USA; Pollock, C. J., Southwest Research Inst., USA; Mozer, F. S., California Univ., USA; Williamson, W. S., Hughes Research Labs., USA; Journal of Spacecraft and Rockets; Nov. 1998; Volume 35, No. 6, pp. 845-849; In English
Contract(s)/Grant(s): NCC8-65; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

This increasingly recognized that the low-energy core plasma is a critically important part of magnetospheric plasma transport, yet this plasma cannot be accurately measured from spacecraft at potentials much different from that of the ambient plasma. In low-density regions such as the polar cap and lobes, spacecraft charge positively, excluding core ions from the spacecraft and accelerating core electrons so much that their velocities cannot be measured with any accuracy. In regions of high electron pressure and temperature, spacecraft charge negatively, excluding the ambient core electrons and accelerating the core ions so much that their velocity cannot be accurately measured. Plasma contactors have been used on a number of spacecraft operating in low-plasma-density regions to prevent charging of spacecraft to high potentials, particularly when exposed to high fluxes of energetic particles. This concern has prompted extensive studies by NASA for use of plasma contractors on the international space station where solar arrays may significantly affect the spacecraft potential.
Derived from text
Plasmas (Physics); Spacecraft Control; Space Plasmas; Solar Arrays; Plasma Density; Energetic Particles; Electron Pressure

19990040203 NASA Goddard Space Flight Center, Greenbelt, MD USA
Ground Testing of Loop Heat Pipes for Spacecraft Thermal Control
Ku, Jentung, NASA Goddard Space Flight Center, USA; Kaya , Tarik, NASA Goddard Space Flight Center, USA; 1999; In English; 33rd; Thermophysics, 28 Jun. - 1 Jul. 1999, Norfolk, VA, USA
Report No.(s): AIAA Paper 99-3447; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

A Loop Heat Pipe (LHP) designed for a space application was tested in different orientations on the ground. The influence of gravitational forces on the LHP performance was discussed for each orientation. The strong dependence of the LHP performance depends significantly on performance characteristics on the orientation was demonstrated. It is shown that the effect of gravity needs to be considered carefully when information obtained on the ground is applied to the space flight conditions. This is particularly important as the LHP investigation is mainly confined to the ground testing due to the complexity and cost of the space flight experiments. The temperature hysteresis phenomenon was also discussed as a part of the LHP experimental verification program.
Author
Heat Pipes; Hysteresis; Temperature Control; Ground Tests; Gravitational Effects

19990040264 NASA Johnson Space Center, Houston, TX USA
Evaluation of Spacecraft Shielding Effectiveness for Radiation Protection
Cucinotta, Francis A., NASA Johnson Space Center, USA; Wilson, John W., NASA Langley Research Center, USA; NASA Microgravity Materials Science Conference; February 1999, pp. 133-138; In English; See also 19990040241; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

The potential for serious health risks from solar particle events (SPE) and galactic cosmic rays (GCR) is a critical issue in the NASA strategic plan for the Human Exploration and Development of Space (HEDS). The excess cost to protect against the GCR and SPE due to current uncertainties in radiation transmission properties and cancer biology could be exceedingly large based on the excess launch costs to shield against uncertainties. The development of advanced shielding concepts is an important risk mitigation area with the potential to significantly reduce risk below conventional mission designs. A key issue in spacecraft material selection is the understanding of nuclear reactions on the transmission properties of materials. High-energy nuclear particles undergo nuclear reactions in passing through materials and tissue altering their composition and producing new radiation types. Spacecraft and planetary habitat designers can utilize radiation transport codes to identify optimal materials for lowering exposures and to optimize spacecraft design to reduce astronaut exposures. to reach these objectives will require providing design engineers with accurate data bases and computationally efficient software for describing the transmission properties of space radiation in materials. Our program will reduce the uncertainty in the transmission properties of space radiation by improving the

theoretical description of nuclear reactions and radiation transport, and provide accurate physical descriptions of the track structure of microscopic energy deposition.
Author
Extraterrestrial Radiation; Radiation Transport; Spacecraft Shielding; Radiation Shielding; Radiation Protection

19990040361 NASA Langley Research Center, Hampton, VA USA
Improved Spacecraft Materials for Radiation Shielding
Wilson, J. W., NASA Langley Research Center, USA; Shinn, J. L., NASA Langley Research Center, USA; Singleterry, R. C., NASA Langley Research Center, USA; Tai, H., NASA Langley Research Center, USA; Thibeault, S. A., NASA Langley Research Center, USA; Simonsen, L. C., NASA Langley Research Center, USA; Cucinotta, F. A., NASA Johnson Space Center, USA; Miller, J., California Univ., Lawrence Berkeley Lab., USA; NASA Microgravity Materials Science Conference; February 1999, pp. 695-701; In English; See also 19990040241; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

In the execution of this proposal, we will first examine current and developing spacecraft materials and evaluate their ability to attenuate adverse biological mutational events in mammalian cell systems and reduce the rate of cancer induction in mice harderian glands as a measure of their protective qualities. The HZETRN code system will be used to generate a database on GCR attenuation in each material. If a third year of funding is granted, the most promising and mission-specific materials will be used to study the impact on mission cost for a typical Mars mission scenario as was planned in our original two year proposal at the original funding level. The most promising candidate materials will be further tested as to their transmission characteristics in Fe and Si ion beams to evaluate the accuracy of the HZETRN transmission factors. Materials deemed critical to mission success may also require testing as well as materials developed by industry for their radiation protective qualities (e.g., Physical Sciences Inc.) A study will be made of designing polymeric materials and composite materials with improved radiation shielding properties as well as the possible improvement of mission-specific materials.
Derived from text
Spacecraft Shielding; Radiation Shielding; Spacecraft Construction Materials; Radiation Hazards; Galactic Cosmic Rays

19990040427 Central Research Inst. of Machine Building, Korolev, Russia
International Conference on Small Satellites: New Technologies, Achievements, Problems and Prospects For International Cooperation In The New Millennium
Jan. 1998; 579p; In Russian; 1st, 16-20 Nov. 1998, Korolyov, Moscow, Russia
Report No.(s): AD-A361105; F61775-99-W-F002; No Copyright; Avail: CASI; A25, Hardcopy; A06, Microfiche

The Final Proceedings for Small Satellites: New technologies, achievements, problems and prospects for international cooperation in the new millennium, 16 November 1998 - 20 November 1998. This is an interdisciplinary conference. Topics include space technology, satellite engineering and space applications.
DTIC
Conferences; Aerospace Engineering; Technology Utilization; Artificial Satellites

19990040465 NASA Goddard Space Flight Center, Greenbelt, MD USA
Innovative Contamination Certification of Multi-Mission Flight Hardware
Hansen, Patricia A., NASA Goddard Space Flight Center, USA; Hughes, David W., Swales Aerospace, USA; Montt, Kristina M., Swales Aerospace, USA; Triolo, Jack J., Swales Aerospace, USA; 20th Space Simulation Conference: The Changing Testing Paradigm; February 1999, pp. 1-13; In English; See also 19990040464; No Copyright; Avail: CASI; A03, Hardcopy; A03, Microfiche

Maintaining contamination certification of multi-mission flight hardware is an innovative approach to controlling mission costs. Methods for assessing ground induced degradation between missions have been employed by the Hubble Space Telescope (HST) Project for the multi-mission (servicing) hardware. By maintaining the cleanliness of the hardware between missions, and by controlling the materials added to the hardware during modification and refurbishment both project funding for contamination recertification and schedule have been significantly reduced. These methods will be discussed and HST hardware data will be presented.
Author
Certification; Maintenance; Space Transportation System; Spacecraft Sterilization; Clean Rooms; Controlled Atmospheres

19990040471 Industrieanlagen-Betriebsgesellschaft m.b.H., Ottobrunn, Germany

Potential and Limitations of the Modal Characterization of a Spacecraft Bus Structure by Means of Active Structure Elements

Grillenbeck, Anton M., Industrieanlagen-Betriebsgesellschaft m.b.H., Germany; Dillinger, Stephan A., Industrieanlagen-Betriebsgesellschaft m.b.H., Germany; 20th Space Simulation Conference: The Changing Testing Paradigm; February 1999, pp. 59-69; In English; See also 19990040464; No Copyright; Avail: CASI; A03, Hardcopy; A03, Microfiche

Theoretical and experimental studies have been performed to investigate the potential and limitations of the modal characterization of a typical truss spacecraft bus structure by means of active structure elements. The aim of these studies was to test and advance tools for performing an accurate on orbit modal identification which may be characterized by the availability of a generally very limited test instrumentation, autonomous excitation capabilities by active structure elements and a zero-g-environment. The NASA LaRC CSI Evolutionary Model Testbed provided an excellent object for the experimental part of this study program. Author

Spacecraft Structures; Space Erectable Structures; Identifying; Substructures; Self Excitation

19990040472 Johns Hopkins Univ., Applied Physics Lab., Laurel, MD USA

Mechanical Flight Qualification Testing of the Advanced Composition Explorer Observatory

Betenbaugh, Teresa M., Johns Hopkins Univ., USA; 20th Space Simulation Conference: The Changing Testing Paradigm; February 1999, pp. 71-104; In English; See also 19990040464; No Copyright; Avail: CASI; A03, Hardcopy; A03, Microfiche

The Advanced Composition Explorer (ACE) Observatory is a National Aeronautics and Space Administration (NASA) Explorer mission with the primary purpose of determining the composition of energetic solar and galactic particles. With a cost cap of $ 141 million, measures were taken to reduce development costs of the observatory. As a part of this effort, a protoflight test program was used to qualify the ACE Observatory. This paper describes the overall mechanical flight qualification program which included vibration, acoustic, shock, and mass properties testing. The ACE project requirements, objectives of the test program, and verification of the project requirements are discussed.
Author

Flight Tests; Qualifications; Shock Tests; Space Missions; Astronomical Observatories; Explorer Satellites

19990040475 Boeing Defense and Space Group, International Space Station Program, Huntsville, AL USA

Leak Rate Testing of the International Space Station Hatch in a Thermal Vacuum Environment

Holt, Angela, Boeing Defense and Space Group, USA; Underwood, Steve, Boeing Defense and Space Group, USA; 20th Space Simulation Conference: The Changing Testing Paradigm; February 1999, pp. 131-140; In English; See also 19990040464; No Copyright; Avail: CASI; A02, Hardcopy; A03, Microfiche

The International Space Station (ISS) Hatch successfully passed extensive leak rate qualification testing in a thermal vacuum environment. Testing was performed at Marshall Space Flight Center in the 10 foot diameter by 12 foot tall ”Sunspot” vacuum chamber. As the Hatch was thermally cycled through its analytically predicted temperature extremes, leak rate tests were performed on all of the Hatch seals using helium mass spectrometer leak detectors. The test setup was designed to provide for maximum test sensitivity and simultaneous leak testing of multiple seals in order to reduce test flow times. The test was part of the Qualification program for the Hatch used on the ISS Nodes, Laboratory, Habitation, and International flight elements.
Author

Hatches; International Space Station; Leakage; Performance Tests; Thermal Environments; Vacuum Chambers; Aerospace Environments; Seals (Stoppers)

19990040476 Boeing Defense and Space Group, International Space Station Program, Huntsville, AL USA

International Space Station Node 1 Helium Accumulation Leak Rate Test

Underwood, Steve, Boeing Defense and Space Group, USA; Holt, Angela, Boeing Defense and Space Group, USA; 20th Space Simulation Conference: The Changing Testing Paradigm; February 1999, pp. 141-147; In English; See also 19990040464; No Copyright; Avail: CASI; A02, Hardcopy; A03, Microfiche

Developmental testing in support of the International Space Station program was performed which verified the methodology, accuracy and sensitivity for the International Space Station (ISS) Node I flight article leak test. The testing was performed in the Space Station Processing Facility (SSPF) located at Kennedy Space Center (KSC), and it evaluated the accumulation test technique of quantifying the leak rate of a pressurized test article located in a container of known volume, the Multiple Mission Support Equipment (MMSE) canister. Three calibrated leaks provided known helium concentrations into the canister over time. The calibrated leaks selected for the test provided helium flow rates which represented the overall Node makeup gas allocation and the approximated Node leakage rate based on individual component testing previously performed. The calibrated leaks were

introduced through an access door penetration located at one end of the MMSE canister. A gas chromatograph thermal conductivity analyzer was used to measure the helium concentrations taken from six sample lines distributed inside the canister. As a result of testing, the helium accumulation technique was selected as the method for determining the Node 1 flight article leak rate. The Node I element-level leak test was conducted March 11-19, 1998, in the SSPF.
Author
International Space Station; Leakage; Test Facilities; Tests; Helium; Accumulations

19990040478 Liege Univ., Facility Dept., Belgium
Environmental Testing at Different Levels of the SEVIRI Payload of the ESA "METEOSAT Second Generation" Program
Jamotton, Pierre, Liege Univ., Belgium; Tychon, Isabelle, Liege Univ., Belgium; Domken, Isabelle, Liege Univ., Belgium; Demaret, David, Liege Univ., Belgium; Balbeur, Henri, Liege Univ., Belgium; Teller, Olivier, Liege Univ., Belgium; Cucchiaro, Antonio, Liege Univ., Belgium; 20th Space Simulation Conference: The Changing Testing Paradigm; February 1999, pp. 159-171; In English; See also 19990040464; No Copyright; Avail: CASI; A03, Hardcopy; A03, Microfiche

In the frame of the European Space Agency METEOSAT SECOND GENERATION meteorological program, the "Centre Spatial de Liege", which is part of the University of Liege (Belgium), has been in charge of recreating in its facilities the main thermal constraints of the mission; and this at four levels: (1) At the detector level (2) At the Passive Cooler Assembly level (with and without detectors) (3) At the payload level. Three of these tests have already been performed successfully. From the Facility point of view, we present here the relevant testing philosophies used to meet the specifications, the related problems, solutions and results.
Author
European Space Agency; Meteosat Satellite; Optical Equipment; Cooling Systems; Environmental Tests; Vacuum Chambers; Test Facilities; Space Environment Simulation

19990040479 Lockheed Martin Astronautics, Denver, CO USA
Thermal Vacuum Testing of the Mars Surveyor Program and Stardust Spacecraft
Breeden, William N., III, Lockheed Martin Astronautics, USA; 20th Space Simulation Conference: The Changing Testing Paradigm; February 1999, pp. 173-187; In English; See also 19990040464; No Copyright; Avail: CASI; A03, Hardcopy; A03, Microfiche

Following the success of the Mars Global Surveyor (MGS), Lockheed Martin Astronautics (LMA) in Denver, CO was awarded two more contracts by NASA to produce spacecraft under the faster, better, cheaper initiative. The first contract, the Mars Surveyor Program (MSP), includes two vehicles, an orbiter and a lander. The Orbiter will launch on December 10, 1998 and move in to orbit around Mars on September 23, 1999. The lander will launch on January 3, 1999 and land on the Martian surface on December 3, 1999. The second contract, Stardust, is the space mission that will fly close to a comet and, for the first time ever, bring cometary material back to Earth for analysis. In support of these two programs, four system level thermal vacuum tests were performed in 1998, three for MSP and one for Stardust. The MSP Orbiter was tested in LMA's 8.8m x 19.8m (29 ft x 65 ft) solar thermal vacuum chamber. The MSP Lander was tested in two configurations. The Lander was tested in its cruise configuration in LMA's 8.8m x 19.8m (29 ft x 65 ft) solar thermal vacuum chamber. The landed configuration was performed in LMA's 5.5 m x 6.lm (18'x 20) thermal vacuum chamber. The Stardust spacecraft will undergo one test in LMA's 5.5 m x 6.lm (18 ft x 20 ft) thermal vacuum chamber.
Author
Thermal Vacuum Tests; Stardust Mission; Mars Polar Lander; Mars Climate Orbiter

19990040480 Intespace, Toulouse, France
A New Method for Thermal Vacuum Tests Telecommunication Spacecraft: The Simulation of Thermal Sink
Marce, Jean-Louis, Intespace, France; Merlet, Joseph, Intespace, France; Yannick, Charles, Intespace, France; Poulain, B., MATRA Marconi Space, France; Gayrard, J., Centre National d'Etudes Spatiales, France; 20th Space Simulation Conference: The Changing Testing Paradigm; February 1999, pp. 189-194; In English; See also 19990040464; No Copyright; Avail: CASI; A02, Hardcopy; A03, Microfiche

The solar simulation chamber has some limitations well known: diameter of solar beam, performance of attitude simulator, of thermal generator, value of irradiation. Their investment costs are high and there is a strong strength : the reduction of test cost which implies to mix functional tests with thermal balance test. A new method is described in this paper which overcomes these difficulties. This method is called simulation of thermal heat sink. This paper presents: (1) The comparison between various simulation methods in thermal vacuum test versus the requirements of test of telecommunication spacecraft with a conclusion of the interest of the simulation of thermal sink. (2) The studies which lead to a prototype of a thermal generator. Various design choices

are explained and justified. In particular, the thermo-hydraulic studies of the shroud which simulates the thermal sink have allowed an optimization of the pressure drop, the thermal gradient and the geometry of the fluid loop. (3) The specification prototype of the thermal generator, its implementation on the SIMMER facility, the results of assessment tests. (4) The design of the operation thermal generator and the final implementation.
Author
Optimization; Prototypes; Shrouds; Thermal Vacuum Tests; Communication Satellites; Thermal Simulation; Space Environment Simulation; Heat Sinks

19990040656 NASA Marshall Space Flight Center, Huntsville, AL USA
Enabling Radiation Tolerant Systems for Space
Kauffman, Billy, NASA Marshall Space Flight Center, USA; Hardage, Donna, NASA Marshall Space Flight Center, USA; 1999; 9p; In English; Space Technology and Applications International Forum, 31 Jan. - 5 Feb. 1999, Albuquerque, NM, USA; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

A hazard to all spacecraft orbiting the Earth is the existence of a harsh environment with its subsequent effects. The effects can provide damaging or even disabling effects on spacecraft and its instruments. One of the most recognized and serious of the different space environments is ionizing radiation and its effects on spacecraft and spacecraft systems. This is increasingly becoming more of an issue for all missions due to the use of lighter composite materials, smaller satellites, and smaller electronics. NASA's Space Environments and Effects (SEE) Program was established to develop new plateaus of technical capability to reduce the cost of NASA's missions and provide leading-edge exploratory and focused technology to promote continued U.S. preeminence in space. The SEE Program has an "Implementation Plan" to develop roadmaps and fund technical tasks to enable radiation systems for space.
Author
Ionizing Radiation; Damage; Spacecraft; Extraterrestrial Radiation

19990040889 Swales Aerospace, Beltsville, MD USA
Assurance of COTS Boards for Space Flight, Part 1
Plante, Jeannette, Swales Aerospace, USA; Helmold, Norm, Swales Aerospace, USA; Eveland, Clay, Swales Aerospace, USA; [1998]; 9p; In English; Commercialization of Military and Space Electronics, USA; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Space Flight hardware and software designers are increasingly turning to Commercial-Off-the-Shelf (COTS) products in hopes of meeting the demands imposed on them by projects with short development cycle times. The Technology Validation Assurance (TVA) team at NASA GSFC has embarked on applying a method for inserting COTS hardware into the Spartan 251 spacecraft. This method includes Procurement, Characterization, Ruggedization/Remediation and Verification Testing process steps which are intended to increase the uses confidence in the hardware's ability to function in the intended application for the required duration. As this method is refined with use, it has the potential for becoming a benchmark for industry-wide use of COTS in high reliability systems.
Author
Computer Programs; Hardware; Reliability; Computers

19990040973 NASA Johnson Space Center, Houston, TX USA
International Space Station Overview
Bates, William V., Jr., NASA Johnson Space Center, USA; Proceedings from the 1998 Occupational Health Conference: Benchmarking for Excellence; February 1999, pp. 46-50; In English; See also 19990040967; No Copyright; Avail: CASI; A01, Hardcopy; A03, Microfiche

The overview of the International Space Station (ISS) is comprised of the program vision and mission; Space Station uses; definition of program phases; as well as descriptions and status of several scheduled International Space Station Overview assembly flights.
Derived from text
International Space Station; General Overviews; Space Station Modules

19
SPACECRAFT INSTRUMENTATION

For related information see also 06 Aircraft Instrumentation and 35 Instrumentation and Photography.

19990040467 Industrieanlagen-Betriebsgesellschaft m.b.H., Ottobrunn, Germany
Contamination Control for Environmental Tests on Optical Instruments
Resch, F., Industrieanlagen-Betriebsgesellschaft m.b.H., Germany; Wuersching, C., Industrieanlagen-Betriebsgesellschaft m.b.H., Germany; 20th Space Simulation Conference: The Changing Testing Paradigm; February 1999, pp. 17-23; In English; See also 19990040464; No Copyright; Avail: CASI; A02, Hardcopy; A03, Microfiche

IABG is operating one of the European Space Agency (ESA) co-ordinated test centres within Europe with test facilities for space simulation/ thermal vacuum testing, vibration, acoustic noise, physical properties, EMC and magnetic field simulation. In this connection environmental tests on optical systems of satellites are performed under specific cleanliness requirements for the test facility and its surrounding equipment. Due to the contamination sensitivity of the optical systems the required cleanliness levels for the integration area but also for the test facility are significantly higher than for 'usual' spacecraft tests. to perform the test programme on the ENVISAT instrument Michelson Interferometer for Passive Atmospheric Sounding (MIPAS) one of IABG's thermal vacuum facilities was upgraded according to the specific test requirements and was integrated in a clean class 100 environmental special precautions were taken for the design of the test facility to meet the cleanliness requirements inside the chamber (class 100 according to Fed. Std. 209). All materials used inside the facility and the integration area where selected with regard to their potential contamination risk for the test article. During previous projects it was experienced that above all the integration and the setting to work phase of a facility is a contamination critical process. Therefore dedicated integration and cleanliness procedure were developed. to monitor the contamination level and the change of contamination versus time contamination measurements (PFO, IR-analyses, etc.) were performed during these phases. Prior to the first tests on flight hardware extensive acceptance and qualification programmes were carried out. The paper will describe the specific measures taken for a reliable contamination control and the related experience gained during the test program. Further it will discuss the results and problems associated with testing under severe cleanliness requirements.
Author
Cleanliness; Contamination; Environmental Tests; Optical Equipment; Test Facilities; Vacuum Chambers

20
SPACECRAFT PROPULSION AND POWER

Includes main propulsion systems and components, e.g., rocket engines; and spacecraft auxiliary power sources. For related information see also 07 Aircraft Propulsion and Power, 28 Propellants and Fuels, 44 Energy Production and Conversion, and 15 Launch Vehicles and Space Vehicles.

19990040199 NASA Marshall Space Flight Center, Huntsville, AL USA
Reuseable Solid Rocket Motor Nozzle Joint-4 Test Correlated Gas Dynamic-Thermal Analysis
Clayton, J. Louie, NASA Marshall Space Flight Center, USA; 1999; In English; 35th; Joint Propulsion, 20-24 Jun. 1999, Los Angeles, CA, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA; Original contains color illustrations; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

This study provides for development and test verification of a gas dynamic-thermal model used for prediction of joint heating environments, structural temperatures and seat erosions in the Space Shuttle Reusable Solid Rocket Motor (RSRM) Nozzle Joint-4. The heating environments are a result of rapid pressurization of the joint free volume assuming a leak path has occurred in the filler material used for assembly gap close out. Combustion gasses flow along the leak path from nozzle environment to joint O-ring gland resulting in local heating to the metal housing and erosion of seal materials. Analysis of this condition was based on usage of the NASA Joint Pressurization Routine (JPR) for environment determination and the Systems Improved Numerical Differencing Analyzer (SINDA) for structural temperature prediction. Model generated temperatures, pressures and seal erosions are compared to hot fire test data for a different leak path situations. Investigated in the hot fire test program were nozzle joint-4 O-ring erosion sensitivities to leak path width in both open and confined joint geometries. Model predictions were in generally good agreement with the test data for the confined leak path cases. Worst case flight predictions are provided using the test-calibrated model. Analysis issues are discussed based on model calibration procedures.
Author
Gas Analysis; Thermal Analysis; Combustible Flow; Finite Difference Theory; Dynamic Models; Heating

19990040201 Boeing Co., Rocketdyne Propulsion and Power, Canoga Park, CA USA

Improvement of Space Shuttle Main Engine Low Frequency Acceleration Measurements

Stec, Robert C., Boeing Co., USA; 1999; 17p; In English; 18th; Aerospace Testing, Mar. 1999, Manhattan Beach, CA, USA; Sponsored by Institute of Environmental Sciences, USA

Contract(s)/Grant(s): NAS8-45000; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The noise floor of low frequency acceleration data acquired on the Space Shuttle Main Engines is higher than desirable. Difficulties of acquiring high quality acceleration data on this engine are discussed. The approach presented in this paper for reducing the acceleration noise floor focuses on a search for an accelerometer more capable of measuring low frequency accelerations. An overview is given of the current measurement system used to acquire engine vibratory data. The severity of vibration, temperature, and moisture environments are considered. Vibratory measurements from both laboratory and rocket engine tests are presented. Author

Space Shuttle Main Engine; Noise (Sound); Data Acquisition; Frequency Measurement; Vibration; Engine Tests

19990040470 ManTech Systems Engineering Corp., Greenbelt, MD USA

Challenging Pneumatic Requirements for Acoustic Testing of the Cryogenic Second Stage for the New Delta 3 Rocket

Webb, Andrew T., ManTech Systems Engineering Corp., USA; 20th Space Simulation Conference: The Changing Testing Paradigm; February 1999, pp. 47-57; In English; See also 19990040464; No Copyright; Avail: CASI; A03, Hardcopy; A03, Microfiche

The paper describes the unique pneumatic test requirements for the acoustic and shock separation testing of the Second Stage for the new Delta III Rocket at the Goddard Space Flight Center in Greenbelt, Maryland. The testing was conducted in the 45,000 ft3 (25-feet wide by 30-feet deep by 50-foot high) Acoustic Facility. The acoustic testing required that the liquid oxygen (LOX) and liquid hydrogen (LH2) tanks be filled with enough liquid nitrogen (LN2) to simulate launch fuel masses during testing. The challenge for this test dealt with designing, procuring, and fabricating the pneumatic supply systems for quick assembly while maintaining the purity requirements and minimizing costs. The pneumatic systems were designed to fill and drain both LOX and LH2 tanks as well as to operate the fill/drain and vent valves for each of the tanks. The test criteria for the pneumatic subsystems consisted of function, cleanliness, availability, and cost. The first criteria, function, required the tanks to be filled and drained in an efficient manner while preventing them from seeing pressures greater than 9 psig, which would add a pressure cycle to the tank. An LN2 tanker, borrowed from another NASA facility, served as the pre-cool and drain tanker. Pre-cooling the tanks allowed for more efficient and cost effective transfer from the LN2 delivery tankers. Helium gas, supplied from a high purity tube trailer, was used to pressurize the vapor space above the LN2 pushing it into the drain tanker. The tube trailer also supplied high pressure helium to the vehicle for valve control and component purges. Cleanliness was maintained by proper component selection, end-use particle filtration, and any on-site cleaning determined necessary by testing. In order to meet the availability/cost juggling act, products designed for LOX delivery systems were procured to ensure system compatibility while off the shelf valves and tubing designed for the semiconductor industry were procured for the gas systems.

Author

Cleanliness; Cryogenics; Liquid Nitrogen; Pneumatics; Delta 3 Launch Vehicle; Tests

19990040766 Sandia National Labs., Safety and Risk Assessment Dept., Albuquerque, NM USA

Nuclear source term analysis for spacecraft power systems

McCulloch, W. H.; Dec. 31, 1998; 5p; In English; Probabilistic safety assessment and management (PSAM4)

Report No.(s): DE99-001059; SAND-98-2009C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

All US space missions involving on-board nuclear material must be approved by the Office of the President. to be approved, the mission and the hardware systems must undergo evaluations of the associated nuclear health and safety risk. One part of these evaluations is the characterization of the source terms, i.e., the estimate of the amount, physical form, and location of nuclear material, which might be released into the environment in the event of credible accidents. This paper presents a brief overview of the source term analysis by the Interagency Nuclear Safety Review Panel for the NASA Cassini Space Mission launched in October 1997. Included is a description of the Energy Interaction Model, an innovative approach to the analysis of potential releases from high velocity impacts resulting from launch aborts and reentries.

NTIS

Spacecraft Power Supplies; Radiation Protection

19990040881 Royal Netherlands Meteorological Inst., De Bilt, Netherlands

The Wind in the Back *De Wind in de Rug*

vanDorp, Henk, Royal Netherlands Meteorological Inst., Netherlands; 1997; In Dutch; Original contains color illustrations

Report No.(s): KNMI-Publ-187; ISBN 90-369-2126-0; Copyright; Avail: Issuing Activity (KNMI, P.O. Box 201, 3730 AE De Bilt, Wilhelminalaan 10, The Netherlands), Hardcopy, Microfiche

How has it all become so, you ask me? That's a story in and of itself, so if you have time... Perhaps I must begin with January 6, 1996, the day that I skated a 75-kilometer trip through Waterland with my neighbor Co. Bart and another pair of experienced eleven-town riders. "If I can easily keep up with these people, they must be riding without much effort themselves; then, perhaps I am able to ride an eleven-town trip," was the secret desire that clung to my heart. Yet, the same afternoon the thaw set in, a thaw that lasted until January 20. Subsequently, on the end of January/beginning of February, winter returned in full glory. At the beginning of the extra wintry blast, a colleague came along with the question: "We are going to do a several-day weather forecast for the Board of directors of the Association of the Frisian Eleven Towns. Would you look to see if this text is good? He asked if I would. I must confess that weather, by and large, does not interest me. As a child I did not keep a weather almanac, and a rain meter in the garden did no more t an attract my attention, somewhat; but get me started on winter weather, ice, and about skating, and a consuming fire bums within me. From November through February, let me see a stream of air that only bends toward a cold front above Western Europe and my heart beats faster. Show me a circulation pattern that has the potential to grow into a freezing winter high-pressure area above Scandinavia, and the blood in my veins begins to boil.

Author

Air Flow; Cold Fronts; Weather Forecasting; High Pressure

19990040926 NASA Marshall Space Flight Center, Huntsville, AL USA

Thermographic Leak Detection of the Space Shuttle Main Engine Nozzle

Walker, James L., Alabama Univ., USA; Russell, Samuel S., NASA Marshall Space Flight Center, USA; 1999; 3p; In English, 22 Mar. 1999, Orlando, FL, USA; Sponsored by American Society for Nondestructive Testing, Inc., USA

Contract(s)/Grant(s): NAG8-1548; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

The Space Shuttle Main Engines Nozzles consist of over one thousand tapered Inconel coolant tubes brazed to a stainless steel structural jacket. Liquid Hydrogen flows through the tubing, from the aft to forward end of the nozzle, under high pressure to maintain a thermal balance between the rocket exhaust and the nozzle wall. Three potential problems occur within the SSME nozzle coolant tubes as a result of manufacturing anomalies and the highly volatile service environment including poor or incomplete bonding of the tubes to the structural jacket, cold wall leaks and hot wall leaks. of these conditions the identification of cold wall leaks has been the most problematic. The methods and results presented in this summary addresses the thermographic identification of cold wall "interstitial" leaks between the structural jacket and coolant tubes of the Space Shuttle Main Engines Nozzles.

Author

Leakage; Monitors; Thermography; Space Shuttle Main Engine; Nozzle Walls; Detection; Exhaust Nozzles; Rocket Exhaust

23
CHEMISTRY AND MATERIALS (GENERAL)

19990040652 Colorado Univ., Inst. of Arctic and Alpine Research, Boulder, CO USA

Humic Substances as Electron Acceptors and Electron Shuttlers in Anaerobic Marine Sediments ***Final Report, 1 Oct. 1996 - 30 Sep. 1998***

McKnight, Diane; Sep. 30, 1998; 5p; In English

Contract(s)/Grant(s): N00014-97-1-0235

Report No.(s): AD-A361022; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

Humic substances are a class of yellow to black colored organic molecules that are recalcitrant and ubiquitous in the environment. Previous research has shown that humic substances can act as electron acceptors in the anoxic oxidation of acetate by Fe(III)-reducing microorganisms. The reduced humic substances were then able to transfer the excess electrons to Fe(III) abiotically. Our hypothesis was that quinone moieties within the humic substances are the primary reducible group. Using electron spin resonance, the organic radical concentration of the humic substances has been shown to increase up to six-fold after incubation with Geobacter Metallireducens. A direct positive correlation exists between the change in organic radicals and the molar concentration of Fe(III) reduced abiotically by the reduced humic substances from many environments. These findings support the hypothesis that quinone moieties are the electron accepting groups within the humic substances. These findings are very important in understanding the reduction of Fe(III) and other metals in anoxic environments, as well as the oxidation of organic contaminants in polluted environments such as marine sediments.

DTIC

Electron Paramagnetic Resonance; Organic Compounds; Microorganisms; Radicals; Acceptor Materials; Electron Transfer; Electrons; Anaerobes; Sediments

19990040866 Iowa State Univ. of Science and Technology, Ames, IA USA
Miscibility, Solubility, Viscosity, and Density Measurements for R-236fa with Potential Lubricants ***Final Report***
Kang, H. M.; Pate, M. B.; Feb. 1999; 91p; In English
Report No.(s): PB99-128027; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

The report gives results of miscibility, solubility, viscosity, and density measurements for refrigerant R-236fa and two potential lubricants. (The data are needed to determine the suitability of refrigerant/lubricant combinations for use in refrigeration systems.) The tested oils were pentaerythritol ester mixed-acid (ISO68), hereafter SW-68 manufactured by Castrol, and polyol ester mixed-acid (ISO46), hereafter Arctic-46 manufactured by Mobil. Miscibility was measured in a series of miniature test cells submerged in a constant temperature bath, precisely controlled over a temperature range of -50 to 90 C. Solubility, viscosity, and density data were also obtained for R-236fa mixed with the two oils for a refrigerant concentration of 0 to 40 wt % refrigerant over a temperature range of 30 to 100 C. This research shows that: (1) solubility, viscosity, and density are functions of temperature and concentration, (2) solubility increases with increasing temperature and refrigerant concentration (i.e., mass fraction of refrigerant). (3) viscosity decreases with increasing temperature and refrigerant concentration, and (4) density decreases with increasing temperature but increases with increasing refrigerant concentration. R-114 and naphthenic mineral oil were also tested.
NTIS
Refrigerants; Lubricants; Viscosity; Density Measurement; Solubility; Miscibility Gap; Miniaturization

24
COMPOSITE MATERIALS

Includes physical, chemical, and mechanical properties of laminates and other composite materials. For ceramic materials see 27 Nonmetallic Materials.

19990039195 Department of Energy, Assistant Secretary for Management and Administration, Washington, DC USA
Shock Hugoniot and release states in concrete mixtures with different aggregate sizes from 3 to 23 GPa
Hall, C. A., Department of Energy, USA; Chhabildas, L. C., Department of Energy, USA; Reinhart, W. D., Department of Energy, USA; Sep. 30, 1997; 6p; In English; Shock Compression of Condensed Matter, USA
Report No.(s): DE98-000193; SAND-97-2011C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

A series of controlled impact experiments has been performed to determine the shock loading and release behavior of two types of concrete, differentiated by aggregate size, but with average densities varying by less than 2 percent. Hugoniot stress and subsequent release data was collected over a range of approximately 3 to 25 GPa using a plate reverberation technique in combination with velocity interferometry. The results of the current data are compared to those obtained in previous studies on concrete with a different aggregate size but similar density. Results indicate that the average loading and release behavior are comparable for the three types of concrete discussed in this paper.
NTIS
Concretes; Stresses; Experimentation; Impact Tests

19990039540 NASA Marshall Space Flight Center, Huntsville, AL USA
MgO-Al2O3-ZrO2 Amorphous Ternary Composite: A Dense and Stable Optical Coating
Shaoo, Naba K., NASA Marshall Space Flight Center, USA; Shapiro, Alan P., NASA Marshall Space Flight Center, USA; Applied Optics; Dec. 01, 1998; Volume 37, No. 34, pp. 8043-8056; In English; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

The process-parameter-dependent optical and structural properties of MgO-Al2O3-ZrO2 ternary mixed-composite material were investigated. Optical properties were derived from spectrophotometric measurements. The surface morphology, grain size distributions, crystallographic phases, and process- dependent material composition of films were investigated through the use of atomic force microscopy, x-ray diffraction analysis, and energy-dispersive x-ray analysis. Energy-dispersive x-ray analysis made evident the correlation between the optical constants and the process-dependent compositions in the films. It is possible to achieve environmentally stable amorphous films with high packing density under certain optimized process conditions.
Author
Magnesium Oxides; Aluminum Oxides; Zirconium Oxides; Amorphous Materials; Coatings; Optical Materials; Research; Stability; Packing Density; Optical Properties

19990039563 North Carolina State Univ., Dept. of Mechanical and Aerospace Engineering, Raleigh, NC USA
Microcracking of Ceramic Matrix Composites at Elevated Temperature ***Final Report, 15 Mar. 1995 - 30 Sep. 1998***
Yuan, Fuh-Gwo; Jan. 01, 1999; 15p; In English

Contract(s)/Grant(s): F49620-95-1-0256
Report No.(s): AD-A361284; AFRL-SR-BL-TR-99-0091; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Ceramic matrix composites (CMC) are potentially designed for use in the high temperature environment because of their high strength and noncatastrophic failure characteristics. For ceramics at elevated temperature, the materials exhibit time-dependent deformation. The phenomenon is further accelerated by an increase in the stress or the temperature. Reinforcement by incorporating high-strength fibers is one of the several approaches to significantly improving the creep fracture resistance of the CMC. Experimental studies in mechanical behavior of CMC (1-4) have shown that failure is preceded by matrix cracking at high temperatures. Further, the creeping matrix causes stress transfer from the matrix to the fiber. However, there is a lack of any investigation in understanding of the relation between the matrix cracking at the micro level and the overall mechanical behavior of CMC at elevated temperature. In this research effort, the crack tip fields for a matrix crack are considered. Using generalized expansions at the crack tip in each region and matching the stresses and displacements across the interface in an asymptotic sense, a series asymptotic solution is constructed for the stresses and strain rates near the crack tip. It is found that the stress singularities, to the leading order, are the same in each material, oscillatory higher-order terms exist in both regions, and stress higher-order term with the order of O(r(exp 0)) appears in the elastic material. The stress exponents and the angular distributions for singular terms and higher order terms are obtained for different creep exponents. A full agreement between asymptotic solutions and the full-field finite element solutions has been obtained.

DTIC

Ceramic Matrix Composites; High Temperature; High Strength; Crack Tips; Microcracks; Fractures (Materials)

19990040179 NASA Langley Research Center, Hampton, VA USA

Evaluation of the Compressive Response of Notched Composite Panels Using a Full-Field Displacement Measurement System

McGowan, David M., NASA Langley Research Center, USA; Ambur, Damodar R., NASA Langley Research Center, USA; Hanna, T. Glen, South Carolina Univ., USA; McNeill, Stephen R., South Carolina Univ., USA; 1999; In English
Report No.(s): AIAA Paper 99-1406; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

An experimental and analytical evaluation of the compressive response of two composite, notched stiffened panels representative of primary composite wing structure is presented. A three-dimensional full-field image correlation technique is used to measure all three displacement components over global and local areas of the test panels. Point-wise and full-field results obtained using the image correlation technique are presented and compared to experimental results and analytical results obtained using nonlinear finite element analysis. Both global and global-local image correlation results are presented and discussed. Results of a simple calibration test of this image correlation technique are also presented.

Author

Displacement Measurement; Graphite-Epoxy Composites; Composite Structures; Wing Panels

19990040180 NASA Langley Research Center, Hampton, VA USA

Analytical Prediction of Damage Growth in Notched Composite Panels Loaded in Axial Compression

Davila, Carlos G., Army Research Lab., USA; Ambur, Damodar R., NASA Langley Research Center, USA; McGowan, David M., NASA Langley Research Center, USA; 1999; In English; 40th; Structures, Structural Dynamics and Materials, 12-15 Apr. 1999, Saint Louis, MO, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Report No.(s): AIAA Paper 99-1435; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

A progressive failure analysis method based on shell elements is developed for the computation of damage initiation and growth in stiffened thick-skin stitched graphite-epoxy panels loaded in axial compression. The analysis method involves a step-by-step simulation of material degradation based on ply-level failure mechanisms. High computational efficiency is derived from the use of superposed layers of shell elements to model each ply orientation in the laminate. Multiple integration points through the thickness are used to obtain the correct bending effects through the thickness without the need for ply-by-ply evaluations of the state of the material. The analysis results are compared with experimental results for three stiffened panels with notches oriented at 0, 15 and 30 degrees to the panel width dimension. A parametric study is performed to investigate the damage growth retardation characteristics of the Kevlar stitch lines in the panels.

Author

Failure Analysis; Fracture Mechanics; Crack Initiation; Crack Propagation; Laminates; Deformation; Damage

19990040181 NASA Langley Research Center, Hampton, VA USA

Response of Composite Plates with Inclined Elliptical Notches and Subjected to Axial Compression

Ambur, Damodar R., NASA Langley Research Center, USA; McGowan, David M., NASA Langley Research Center, USA; 1999;

In English; 40th; Structures, Structural Dynamics, and Materials, 12-15 Apr. 1999, Saint Louis, MO, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Report No.(s): AIAA Paper 99-1276; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

An analysis method for predicting the inplane stress states in anisotropic finite plates with an elliptical notch is presented. This method can be used to analyze plates with arbitrary notch orientations with respect to the plate material axes. The analysis results have been validated using finite element analysis results for unnotched composite plates and experimental and finite element analysis results for stiffened composite panels with a skin that has orthotropic properties. The good agreement between these results, until the panel exhibits nonlinear response either due to bending or initiation of damage, indicates that the present analysis method can be used to determine accurately the inplane stress states and stress concentrations at and around an elliptical notch. Author

Anisotropic Plates; Shear Strain; Stress Concentration; Compressibility; Ellipticity; Notches

19990040432 Boeing Co., Huntington Beach, CA USA

Cryotank Skin/Stringer Bondline Analysis

Nguyen, Bao, Boeing Co., USA; 1999; 13p; In English; 44th, 23-27 May 1999, Long Beach, CA, USA; Sponsored by Society for the Advancement of Materials and Process Engineering, USA
Contract(s)/Grant(s): NCC8-35; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The need for light weight structure for advanced launch systems have presented great challenges and led to the usage of composites materials in a variety of structural assemblies where joining of two or more components is imperative. Although joints can be mechanically bolted, adhesive bonding has always been a very desirable method for joining the composite components, particularly for the cryotank systems, to achieve maximum structural efficiency. This paper presents the analytical approach resulted from the conceptual development of the DC-Y composite cryotank, conducted under the NASA/Boeing NRA 8-12 Partnership, to support the continued progress of SSTO (Single-Stage-to-Orbit) concepts. One of the critical areas of design was identified as the bonded interface between the skin (tank wall) and stringer. The approach to analyze this critical area will be illustrated through the steps which were used to evaluate the structural integrity of the bondline. Detailed finite element models were developed and numerous coupon test data were also gathered as part of the approach. Future plan is to incorporate this approach as a building block in analyzing bondline for the cryotank systems of RLVs (Reusable Launch Vehicles).
Author

Launch Vehicles; Adhesive Bonding; Bonded Joints; Composite Materials

19990040466 Johns Hopkins Univ., Applied Physics Lab., Laurel, MD USA

Water Outgassing From Multi-Layer Insulation Blankets as a Diffusion Controlled Process

Silver, David M., Johns Hopkins Univ., USA; 20th Space Simulation Conference: The Changing Testing Paradigm; February 1999, pp. 15; In English; See also 19990040464; No Copyright; Avail: CASI; A01, Hardcopy; A03, Microfiche; Abstract Only; Abstract Only

Water is a pervasive molecular species that is inherent as a constant in spacecraft materials, especially Multi-Layer Insulation (MLI) blankets. On orbit the outgassing of water occurs at rates that make a potential deleterious contaminant for cryogenic optical surfaces, either from direct, ricochet or collisional return flux. The outgassing process persists over time and is temperature dependent. Laboratory measurements are available on the outgassing of water from MLI blanket materials, which include single-sided and double-sided metalized plastic films and synthetic netting. The results span a range of outgassing temperatures (-50 C to +20 C) over a time span of approx. 100 hours. Empirical fits of these data have been assembled for each layer of a twenty layer, double aluminized mylar (DAM) and Dacron netting (DN), MLI blanket (each layer at a specified temperature) to from an MLI blanket model. The MLI blanket model has been used to make predictions of the water outgassing environment for the Midcourse Space Experiment (MSX) spacecraft, launched in April 1996. Comparisons of the model with MSX on-orbit measurements, from a neutral mass spectrometer, total pressure sensor, krypton flash lamp and radiometer, showed excellent agreement for the first several hundred hours of spaceflight. However, the laboratory data forming the basis of the empirical model had been collected for only 100 hours and the consequences of extrapolating an empirical fitting to longer times became apparent from comparisons of on-orbit measurements taken about after 1000 hours of spaceflight. The fundamental physical processes in outgassing of water from MLI materials are diffusion through the interstitial spaces and evaporation from the bounding surfaces. Since diffusion is the controlling mechanism, the approach described here is to use the solutions of the diffusion equations fitted to the boundary conditions and results of the laboratory experiments to construct a time and temperature dependent outgassing model. Then it is the time dependence of the physics-based governing differential equations that predict the behavior at long times. Such a model has been

constructed for DAM-DN and incorporated into an MLI blanket model. Predictions from this model will be compared with on-orbit measurements collected by the MSX flight instruments over the past year.
Author
Diffusion; Outgassing; Water; Blankets; Multilayer Insulation; Spacecraft Construction Materials

19990040468 Lockheed Martin Missile and Space, Sunnyvale, CA USA
Moisture Content and Desorption Rate of a GR/EP Honeycomb Panel
Lee, Aleck L., Lockheed Martin Missile and Space, USA; 20th Space Simulation Conference: The Changing Testing Paradigm; February 1999, pp. 25-34; In English; See also 19990040464; No Copyright; Avail: CASI; A02, Hardcopy; A03, Microfiche

A diffusion outgassing model has been developed to predict the moisture content, concentration distribution and the surface desorption rate of a graphite epoxy panel as a function of temperature and time. The model was applied to a honeycomb panel with aluminum core and graphite epoxy face sheets. The analytical results have been used to predict the internal pressure of a spacecraft during a thermal vacuum test and to determine the temperature and the duration of the thermal vacuum bakeout. An example of the latter application related to the attitude reference platform of a scientific satellite is discussed. The results show that, with an initial moisture content of 0.002 by weight, the average moisture concentration in a 64-mil graphite epoxy panel is reduced to 1/10 of its initial value after 49 days at 240K. For a hot case at 250K, it requires 43 days to reduce the moisture content to the same level. The model was also applied to find the temperature of the face sheet so that the moisture content is reduced to 10% or 5% of its initial value in 30 days. The answers are 21.2F (267K) and 54.5F (285.5K), respectively, for the two-sided model.
Author
Desorption; Graphite-Epoxy Composites; Honeycomb Structures; Moisture Content; Outgassing; Mathematical Models

19990040536 Department of Energy, Assistant Secretary for Management and Administration, Washington, DC USA
Powder-based synthesis of nanocrystalline material components for structural application ***Final Report***
Ilyuschenko, A. F., Department of Energy, USA; Ivashko, V. S., Department of Energy, USA; Okovity, V. A., Department of Energy, USA; Dec. 31, 1998; 137p; In English
Report No.(s): DE99-001035; LA-SUB-98-26; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Hydroxiapate spray coatings and substrates for implant production as well as multilayered metal ceramic coatings from nanocrystalline materials are a subject of the investigation. The work aims at the improvement of quality of said objects. This study has investigated the processes of hydroxiapatite powder production. Sizes, shapes and relief of initial HA powder surface are analyzed using SEM and TEM. Modes of HA plasma spraying on a substrate from titanium and associated compositions of traditional and nanocrystalline structure are optimized. The quality of the sprayed samples are studied using X- ray phase analysis and metallographic analysis. The results of investigations of bioceramic coating spraying on titanium are theoretically generalized, taking into account obtained experimental data. The results of investigations of ion-beam technology are presented for spraying multilayered coatings consisting of alternating metal-ceramic layers of nanocrystalline structure.
NTIS
Calcium Phosphates; Aluminum Oxides; Microstructure; Plasma Spraying; Metal Coatings; Ceramic Coatings; Coating; Arc Spraying

19990040577 NASA Lewis Research Center, Cleveland, OH USA
Large Deformation Nonlinear Response of Soft Composite Structures via Laminate Analogy
Chamis, Christos C., NASA Lewis Research Center, USA; Mauget, Bertrand R., Clarkson Univ., USA; Minnetyan, Levon, Clarkson Univ., USA; 1998; In English; 8th; Composite Materials, 24-26 Sep. 1998, USA; No Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

The large deformation behavior of fiber preform and angle ply composites with very soft matrix is the subject of this paper. For these materials, large strains and therefore significant changes in the fiber orientations occur due to the application of small traction, thus drastically changing their mechanical properties. The present method uses a laminate analogy model with very low stiffness matrix to compute the finite element properties. The assumptions are made that fibers do not elongate, the laminate is made of symmetrically woven fibers and that during a finite element step the properties can be supposed constant. Based on these assumptions, a simple way to compute the fiber changes is proposed, as it is remarked that a box with fibers as its diagonal will deform into a box of different aspect ration. The large displacement approach is valid since the properties depend on the global Poisson ratio computation that is proved accurate. A traction test is simulated to demonstrate the method.
Author
Deformation; Fiber Composites; Composite Structures; Fiber Orientation; Elongation; Laminates

19990040595 NASA Langley Research Center, Hampton, VA USA

Evaluation of a Scaling Approach for Stiffened Composite Flat Panels Loaded in Compression

Rouse, Marshall, NASA Langley Research Center, USA; Assadi, Mahyar, Boeing Commercial Airplane Co., USA; 1999; In English; 40th; Structures, Structural Dynamics and Material, 12-15 Apr. 1999, Saint Louis, MO, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Report No.(s): AIAA Paper 99-1404; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

Results of an experimental study of the effects of geometric scaling on a graphite-epoxy flat stiffened-skin panel concept loaded in compression are presented. The scaled models were fabricated using an approach to laminate thickness scaling, referred to as the ”ply-thickness method.” The structural response and failure characteristics of full-, half-, and quarter-scale specimens fabricated with this scaling concept are discussed and compared. The scaled up failure loads of the half- and quarter-scale models agree well with the failure load of the full-scale prototypes tested. The strength scale effects observed in the results were substantially smaller than those in earlier studies that employed other laminate scaling techniques. The experimental results indicate that failure initiated by crippling and delamination in the cap of the longitudinal stiffeners and skin-stiffener separation at the bondlines, and was followed by failure of the specimen skin. Nonlinear finite element analysis results correlate well with experimental results up to failure.

Author

Composite Structures; Graphite-Epoxy Composites; Scale Models; Scaling Laws; Failure

19990040625 Case Western Reserve Univ., Dept. of Materials Science and Engineering, Cleveland, OH USA

Fiber Effects on Minicomposite Mechanical Properties for Several SiC-Fiber CVI-SiC Matrix Systems

Morscher, Gregory N., Case Western Reserve Univ., USA; Martinez-Fernandez, Julian, Seville Univ., Spain; 1997; 33p; In English; No Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

Several different types of SiC fiber tows were coated with BN and composited using CVI SiC to form single tow minicomposites. The SiC fiber-types included Nicalon (TM), Hi-Nicalon (TM), and the new polycrystalline SiC Sylramic (TM) fiber. The interfacial shear stresses were determined from unload-reload tensile hysteresis loop tests. The ultimate stress and strain properties were also determined for the minicomposites. The ultimate strengths of the newer Hi-Nicalon and Sylramic fibers were superior to that of Nicalon minicomposites with similar fiber volume fractions. The Sylramic minicomposites had the lowest strain to failure and highest interfacial shear strength, respectively, due to the high modulus of the fiber and the rough surface of this fiber type. The interfacial shear strength appeared to increase with increasing stress for Sylramic minicomposites which was also attributed to the surface roughness of this fiber.

Author

Mechanical Properties; Silicon Carbides; Fiber-Matrix Interfaces; Fiber Composites; Ceramic Matrix Composites

19990040692 Los Alamos National Lab., NM USA

Molecular dynamics simulations and thermochemistry of reactive ion etching of silicon by chlorine, chlorine dimer, bromine, and bromine dimer cations

Valone, S. M.; Hanson, D. E.; Kress, J. D.; May 08, 1998; 7p; In English; Modeling and simulation of microsystems, semiconductors, sensors and actuators

Report No.(s): DE99-000765; LA-UR-98-2183; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Simulations of Cl plasma etch of Si surfaces with MD techniques agree reasonably well with the available experimental information on yields and surface morphologies. This information has been supplied to a Monte Carlo etch profile resulting in substantial agreement with comparable inputs provided through controlled experiments. to the extent that more recent measurements of etch rates are more reliable than older ones, preliminary MD simulations using bond-order corrections to the atomic interactions between neighboring Si atoms on the surface improves agreement with experiment through an increase in etch rate and improved agreement with XPS measurements of surface stoichiometry. Thermochemical and geometric analysis of small Si-Br molecules is consistent with the current notions of the effects of including brominated species in etchant gases.

NTIS

Molecular Dynamics; Thermochemistry; Reactivity; Silicon; Chlorine; Bromine; Cations; Plasma Etching; Computerized Simulation; Dimers

19990040816 National Academy of Sciences - National Research Council, Moffett Field, CA USA

Comparison Between Navier-Stokes and Thin-Layer Computations for Separated Supersonic Flow

Degani, David, National Academy of Sciences - National Research Council, USA; Steger, Joseph L., Stanford Univ., USA; AIAA Journal; November 1983; Volume 21, No. 11, pp. 1604-1606; In English; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

In the numerical simulation of high Reynolds-number flow, one can frequently supply only enough grid points to resolve the viscous terms in a thin layer. As a consequence, a body-or stream-aligned coordinate system is frequently used and viscous terms in this direction are discarded. It is argued that these terms cannot be resolved and computational efficiency is gained by their neglect. Dropping the streamwise viscous terms in this manner has been termed the thin-layer approximation. The thin-layer concept is an old one, and similar viscous terms are dropped, for example, in parabolized Navier-Stokes schemes. However, such schemes also make additional assumptions so that the equations can be marched in space, and such a restriction is not usually imposed on a thin-layer model. The thin-layer approximation can be justified in much the same way as the boundary-layer approximation; it requires, therefore, a body-or stream-aligned coordinate and a high Reynolds number. Unlike the boundary-layer approximation, the same equations are used throughout, so there is no matching problem. Furthermore, the normal momentum equation is not simplified and the convection terms are not one-sided differenced for marching. Consequently, the thin-layer equations are numerically well behaved at separation and require no special treatment there. Nevertheless, the thin-layer approximation receives criticism. It has been suggested that the approximation is invalid at separation and, more recently, that it is inadequate for unsteady transonic flow. Although previous comparisons between the thin-layer and Navier-Stokes equations have been made, these comparisons have not been adequately documented.

Author

Computational Grids; Navier-Stokes Equation; Thin Films; Supersonic Flow; Separated Flow; Boundary Layers

19990040874 Oak Ridge National Lab., TN USA

Mechanics model for the deformation of swirl-mat composites

Elahi, M.; Weitsman, Y. J.; Dec. 31, 1998; 6p; In English; 13th; Annual ESD advanced composite technology

Report No.(s): DE99-000217; ORNL/CP-99308; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Swirl-mat polymeric composites are considered as representative materials for application in the automotive industry. This article summarizes a three- year long effort to characterize, model, and predict the deformation of these composites under stress, temperature, cyclic loadings, and the ingress of fluids. The effort involved several hundred characterization tests of various kinds and the formulation of a constitutive model based upon fundamental principles of irreversible thermodynamics and continuum mechanics. The above- mentioned experiments and model development were performed interactively. Subsequently, the model was employed in a predictive manner to anticipate experimental data collected under complex load and temperature histories, as well as to predict long-term behavior from short-term data.

NTIS

Mathematical Models; Continuum Mechanics; Composite Materials

19990040875 Oak Ridge National Lab., TN USA

Static properties and multiaxial strength criterion for design of composite automotive structures

Ruggles, M. B.; Yahr, G. T.; Battiste, R. L.; Dec. 31, 1998; 7p; In English; 13th; Annual ESD advanced composite technology

Report No.(s): DE99-000209; ORNL/CP-99199; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The Durability of Lightweight Composite Structures Project was established at Oak Ridge National Laboratory (ORNL) by the US Department of Energy to provide the experimentally-based, durability-driven design guidelines necessary to assure long-term structural integrity of automotive composite components. The initial focus of the ORNL Durability Project was on one representative reference material -- an isocyanurate (polyurethane) reinforced with continuous strand, swirl-mat E-glass. The present paper describes tensile, compressive, flexure, and shear testing and results for the reference composite. Behavioral trends and proportional limit are established for both tension and compression. Damage development due to tensile loading, strain rate effects, and effects of temperature are discussed. Furthermore, effects on static properties of various fluids, including water at room and elevated temperatures, salt water, antifreeze, windshield washer fluid, used motor oil, battery acid, gasoline, and brake fluid, were investigated. Effects of prior loading were evaluated as well. Finally, the effect of multiaxial loading on strength was determined, and the maximum shear strength criterion was identified for design.

NTIS

Criteria; Composite Structures; Composite Materials; Shear Strength

19990040924 Pennsylvania Dept. of Transportation, Bureau of Construction and Materials, Harrisburg, PA USA
Fiber Column Wrap Seismic Retrofit System ***Final Report, Aug. 1993 - Jul. 1998***
Sukley, R.; Howrylak, C.; Nov. 1998; 40p; In English; Original contains color illustrations
Report No.(s): PB99-130684; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The TYFO-S FIBRWRAP System incorporates high strength composite fibers and epoxy resin for the seismic retrofitting of concrete columns to increase their ability to withstand loading under seismic activity, and to offer an alternative to steel jackets. The manufacturer, R.J. Watson, Inc. claims that its product is economical and easy to install. The objective of this research final report is to evaluate the performance, durability, and cost effectiveness of using the TYFO-S FIBRWRAP System for seismic retrofitting.

NTIS
Retrofitting; Composite Wrapping; Earthquake Resistant Structures; Bridges (Structures)

19990040943 Oak Ridge National Lab., TN USA
Fatigue behavior and recommended design rules for an automotive composite
Corum, J. M.; Battiste, R. L.; Ruggles, M. B.; Dec. 31, 1998; 8p; In English; 13th; Annual ESD advanced composite technology
Report No.(s): DE99-000226; ORNL/CP-99197; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Fatigue curves (stress vs cycles to failure) were generated under a variety of conditions (temperatures, fluid environments, mean stresses, block loadings) for a candidate automotive structural composite. The results were used to (1) develop observations regarding basic fatigue behavioral characteristics and (2) establish fatigue design rules. The composite was a structural reaction injection-molded polyurethane reinforced with continuous strand, swirl-mat E-glass fibers. Tensile fatigue tests on specimens from a single plaque at -40 F, room temperature, and 250 F provided the basic behavioral characteristics. It was found that when stress was normalized by the at- temperature ultimate tensile strength, the fatigue curves at the three temperatures collapsed into a single master curve. An assessment of the individual stress-strain loops throughout each test showed a progressive loss in stiffness and an increase in permanent strain, both of which are indicative of increasing damage. Fatigue tests on specimens from several plaques were used to develop a design fatigue curve, which was established by using a reduction factor of 20 on average cycles to failure. This factor assures that the stiffness loss during the design life is no greater than 10 percent. Fatigue reduction factors were established to account for various fluids. Reversed stress fatigue tests allowed a mean stress rule to be validated, and block loading tests were used to demonstrate the adequacy of Miner's rule for cumulative fatigue damage.

NTIS
Fatigue (Materials); Automobiles; Composite Materials; Design Analysis

19990041038 Oak Ridge National Lab., TN USA
Oxidation resistant coatings for ceramic matrix composite components
Vaubert, V. M.; Stinton, D. P.; Hirschfeld, D. A.; Dec. 31, 1998; 12p; In English; 100th; Annual meeting of the American Ceramic Society
Report No.(s): DE99-000383; ORNL/CP-99074; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Corrosion resistant Ca(0.6)Mg(0.4)Zr4(PO(sub 4)(sub 6) (CMZP) and Ca(0.5)SR(0.5)Zr4(PO(sub 4))(sub 6) (CS-50) coatings for fiber-reinforced SiC-matrix composite heat exchanger tubes have been developed. Aqueous slurries of both oxides were prepared with high solids loading. One coating process consisted of dipping the samples in a slip. A tape casting process has also been created that produced relatively thin and dense coatings covering a large area. A processing technique was developed, utilizing a pre-sintering step, which produced coatings with minimal cracking.

NTIS
Protective Coatings; Composite Materials; Corrosion Resistance; Oxidation; Coating; Ceramic Matrix Composites

19990041100 NASA Langley Research Center, Hampton, VA USA
Utilization of Induction Bonding for Automated Fabrication of TIGR
Hinkley, Jeffrey A., NASA Langley Research Center, USA; Johnston, Norman J., NASA Langley Research Center, USA; Hulcher, A. Bruce, Old Dominion Univ., USA; Marchello, Joseph M., Old Dominion Univ., USA; Messier, Bernadette C., Old Dominion Univ., USA; April 1999; 44p; In English
Contract(s)/Grant(s): RTOP 537-06-32-20
Report No.(s): NASA/TM-1999-209123; L-17787; NAS 1.15:209123; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A laboratory study of magnetic induction heat bonding of titanium foil and graphite fiber reinforced polymer prepreg tape, TiGr, demonstrated that the process is a viable candidate for low cost fabrication of aircraft structure made of this new material

form. Data were obtained on weld bonding of PIXA and PETI-5 prepreg to titanium. Both the foil and honeycomb forms of titanium were investigated. The process relies on magnetic susceptor heating of titanium, not on high frequency heating of graphite fiber. The experiments showed that with a toroid magnet configuration, good weld bonds might be obtained with heating times of a few seconds. These results suggest the potential is good for the induction heating process to achieve acceptable commercial production rates.
Author
Titanium; Welding; Foils (Materials); Honeycomb Structures; Graphite-Polyimide Composites; Research; Laboratories; Technology Utilization

19990041101 NASA Langley Research Center, Hampton,VA USA
Analyses of Fatigue Crack Growth and Closure Near Threshold Conditions for Large-Crack Behavior
Newman, J. C., Jr., NASA Langley Research Center, USA; Apr. 1999; 32p; In English; Fatigue Crack Growth Thresholds, Endurance Limits, and Design (ASTM STP-1372), 4-5 Nov. 1998, Norfolk, VA, USA; Sponsored by American Society for Testing and Materials, USA
Contract(s)/Grant(s): RTOP 522-18-11-01
Report No.(s): NASA/TM-1999-209133; L-17842; NAS 1.15:209133; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A plasticity-induced crack-closure model was used to study fatigue crack growth and closure in thin 2024-T3 aluminum alloy under constant-R and constant-K(sub max) threshold testing procedures. Two methods of calculating crack-opening stresses were compared. One method was based on a contact-K analyses and the other on crack-opening-displacement (COD) analyses. These methods gave nearly identical results under constant-amplitude loading, but under threshold simulations the contact-K analyses gave lower opening stresses than the contact COD method. Crack-growth predictions tend to support the use of contact-K analyses. Crack-growth simulations showed that remote closure can cause a rapid rise in opening stresses in the near threshold regime for low-constraint and high applied stress levels. Under low applied stress levels and high constraint, a rise in opening stresses was not observed near threshold conditions. But crack-tip-opening displacement (CTOD) were of the order of measured oxide thicknesses in the 2024 alloy under constant-R simulations. In contrast, under constant-K(sub max) testing the CTOD near threshold conditions were an order-of-magnitude larger than measured oxide thicknesses. Residual-plastic deformations under both constant-R and constant-K(sub max) threshold simulations were several times larger than the expected oxide thicknesses. Thus, residual-plastic deformations, in addition to oxide and roughness, play an integral part in threshold development.
Author
Crack Propagation; Displacement; Fatigue (Materials); Aluminum Alloys; Crack Tips

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INORGANIC AND PHYSICAL CHEMISTRY

Includes chemical analysis, e.g., chromatography; combustion theory; electrochemistry; and photochemistry. For related information see also 77 Thermodynamics and Statistical Physics.

19990038388 Massachusetts Univ., Dept. of Microbiology, Amherst, MA USA
Anaerobic Oxidation of Hydrocarbon Contaminants in Marine and Estuarine Sediments ***Final Report, 15 Nov. 1995 - 30 Sep. 1998***
Lovley, Derek R.; Mar. 31, 1999; 5p; In English
Contract(s)/Grant(s): N00014-96-1-0243
Report No.(s): AD-A361508; Rept-98A1398; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

The potential for anaerobic degradation of polycyclic aromatic hydrocarbons (PARs) in contaminated harbor sediments was investigated. PARs were anaerobically oxidize to carbon dioxide in petroleum contaminated sediments from San Diego Bay, Tampa Bay and Boston Harbor. Studies with molybdate, a specific inhibitor of sulfate reduction, as well as investigations in which sulfate levels were varied, demonstrated that PAR oxidation was coupled to sulfate reduction. Pristine harbor sediments did not have a significant potential for anaerobic PAH oxidation, but could be adapted for PAH oxidation by exposure to PAhs or inoculation with PAH-oxidizing microorganisms. Exposure of pristine sediments to PAH resulted in the growth of PAH-oxidizing microorganisms. PARs added to sediments as part of complex fuel mixtures were degraded. The alkanes in the complex fuel mixtures were also anaerobically degraded under sulfate reducing conditions. In estuarine sediments in which concentrations of sulfate were low, PAR and alkane degradation could be stimulated with the addition of sulfate. These studies have demonstrated for the

first time that PARs can be oxidized under the anaerobic conditions that predominant in most contaminated harbor sediments and suggest that anaerobic strategies for
DTIC
Contaminants; Oxidation; Polycyclic Aromatic Hydrocarbons; Marine Chemistry; Anaerobes

19990039105 Air Force Inst. of Tech., School of Engineering, Wright-Patterson AFB, OH USA
Collisional Effects in the Absorption Spectra of the Oxygen a Band and Nitric Oxide Fundamental Band
Pope, Robert S.; Dec. 1998; 307p; In English
Report No.(s): AD-A361408; AFIT/DS/ENP/98-03; No Copyright; Avail: Issuing Activity (Defense Technical Information Center (DTIC)), Microfiche

Fourier transform spectroscopy was used to measure pressure broadening coefficients in the absorption spectra of both the oxygen A band and the nitric oxide fundamental band. Oxygen spectra were recorded with O2, N2, CO, CO2, SF6 and noble gas collision partners, while nitric oxide spectra were recorded using noble gas collision partners. Pressure broadening coefficients were determined in the P and R branches for every resolved line for each of the fifteen collision pairs studied. In addition, broadening coefficients and qualitative evidence of line coupling were found for the Q branch of NO + Ar and pressure-induced line shifting coefficients were measured for O2 + Xe. Elastic and inelastic theories of pressure broadening were used to interpret the observed broadening coefficients. The elastic model showed a strong correlation between the magnitude of the coefficients and the polarizability and mass of the perturbed. The inelastic contribution to pressure broadening was modeled using both angular-momentum-based and energy-based fitting laws. The ECS-P and EPGL-O laws provided the best fits to the data. The results indicate that the inelastic component is an important contribution to collisional broadening in diatomic molecules and that angular-momentum transfer is a plausible governing mechanism for the inelastic collisions.
DTIC
Absorption Spectra; Nitric Oxide; Oxygen Spectra; Inelastic Collisions

19990039543 NASA Goddard Space Flight Center, Greenbelt, MD USA
Low-Cost, Single-Frequency Sources for Spectroscopy Using Conventional Fabry-Perot Diode Lasers
Krainak, Michael A., NASA Goddard Space Flight Center, USA; Duerksen, Gary L., Maryland Univ., USA; 1999; 4p; In English; Advanced Semiconductor Lasers, 21-23 Jul. 1999, USA; Sponsored by Institute of Electrical and Electronics Engineers, USA; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

Commercial (uncoated) Fabry-Perot laser diodes are converted to single-frequency spectroscopy sources by passively locking the laser frequency to the band edge of a fiber Bragg grating, which phase-locks the laser oscillations through self-injection seeding.
Author
Laser Spectroscopy; Semiconductor Lasers; Spectrum Analysis; Spectral Emission

19990039558 Air Force Inst. of Tech., School of Engineering, Wright-Patterson AFB, OH USA
Use of Diffuse Reflectance Spectroscopy to Determine Desorption Coefficients of Trichioroethylene from Powdered Soils
Foil, Jay H.; Mar. 1999; 79p; In English
Report No.(s): AD-A361372; AFIT/GAP/ENP/99M-02; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

This laboratory thesis investigated the applicability of reflectance spectroscopy as a tool to measure desorption rates by directly observing the change in trichloroethylene bound to surface sites. Diffuse reflectance spectroscopy holds the promise of being a faster technique with minimal sample preparation time. Reflectance spectroscopy's dependence on the surface of the sample is its greatest advantage, as well as its greatest disadvantage. Both high and low resolution scans were made of different soil samples contaminated by trichloroethylene. After the technique of spectral subtraction was used, potential TCE signals were observed from the dolomitic limestone sample. Unfortunately, due to the low level of the signal and high amount of noise, positive identification of the signals as TCE could not be established. The low resolution scans were unable to detect any possible TCE signals. More data is required to determine the sensitivity of the device as well as prove the linearity of the signal with concentration, before this technique can be proven to be useful for studying desorption kinetics.
DTIC
Spectroscopy; Reflectance; Trichloroethylene; Diffuse Radiation

19990039588 Department of Energy, Assistant Secretary for Management and Administration, Washington, DC USA
Preparation and evaluation of novel hydrous metal oxide (HMO)-supported noble metal catalysts
Gardner, T. J., Department of Energy, USA; McLaughlin, L. I., Department of Energy, USA; Evans, L. R., Department of Energy,

USA; Datye, A. K., Department of Energy, USA; Apr. 30, 1998; 12p; In English; 7th; Scientific Bases for the Preparation of Heterogeneous Catalysts, USA
Report No.(s): DE98-005780; SAND-98-0879C; CONF-980908; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Hydrous Metal Oxides (HMOs) are chemically synthesized materials that, because of their high cation exchange capacity, possess a unique ability to allow the preparation of highly dispersed supported-metal catalyst precursors with high metal loadings. This study evaluates high weight loading Rh/HMO catalysts with a wide range of HMO support compositions, including hydrous titanium oxide (HTO), silica-doped hydrous titanium oxide (HTO:Si), hydrous zirconium oxide (HZO), and silica-doped hydrous zirconium oxide (HZO:Si), against conventional oxide-supported Rh catalysts with similar weight loadings and support chemistries. Catalyst activity measurements for a structure-sensitive model reaction (n-butane hydrogenolysis) as a function of catalyst activation conditions show superior activity and stability for the ZrO(sub 2), HZO, and HZO:Si supports, although all of the Rh/HMO catalysts have high ethane selectivity indicative of high Rh dispersion. For the TiO(sub 2)-, HTO-, and HTO:Si supported Rh catalysts, a significant loss of both catalyst activity and Rh dispersion is observed at more aggressive activation conditions, consistent with TiO(sub x) migration associated with SMSI phenomena. of all the Rh/HMO catalysts, the Rh/HZO:Si catalysts appear to offer the best tradeoff in terms of high Rh dispersion, high activity, and high selectivity.
NTIS
Evaluation; Metal Oxides; Hydrogenolysis; Catalysts

19990039592 Department of Energy, Office of Energy Research, Washington, DC USA
Nanorheology of Liquid Alkanes
Gupta, S. A., Department of Energy, USA; Sep. 30, 1997; 19p; In English; 13th; Thermophysical Properties, USA
Report No.(s): DE98-000336; ORNL/CP-94432; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

We report molecular dynamics simulations of liquid alkanes, squalane and tetracosane, confined between moving walls to which butane chains are tethered, effectively screening the details of the wall. As in an experiment, heat is removed by thermostatting the tethered molecules. Results obtained at high strain rates, typical of practical applications, suggest little or no difference between the bulk rheology and confined flow, and the occurrence of a high degree of slip at the wall-fluid interface at the conditions studied. At relatively low velocities and high densities, tetracosane shows the formation of fully-extended chains at certain wall spacings.
NTIS
Alkanes; Molecular Dynamics; Liquids; Rheology

19990039599 Department of Energy, Assistant Secretary for Energy Efficiency and Renewable Energy, Washington, DC USA
Ignition of hydrogen/air mixing layer in turbulent flows
Im, H. G., Department of Energy, USA; Chen, J. H., Department of Energy, USA; Law, C. K., Department of Energy, USA; Mar. 31, 1998; 30p; In English; 27th; Cumbustion, USA
Report No.(s): DE98-052537; SAND-98-8477C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Autoignition of a scalar hydrogen/air mixing layer in homogeneous turbulence is studied using direct numerical simulation. An initial counterflow of unmixed nitrogen-diluted hydrogen and heated air is perturbed by two-dimensional homogeneous turbulence. The temperature of the heated air stream is chosen to be 1,100 K which is substantially higher than the crossover temperature at which the rates of the chain branching and termination reactions become equal. Three different turbulence intensities are tested in order to assess the effect of the characteristic flow time on the ignition delay. For each condition, a simulation without heat release is also performed. The ignition delay determined with and without heat release is shown to be almost identical up to the point of ignition for all of the turbulence intensities tested, and the predicted ignition delays agree well within a consistent error band. It is also observed that the ignition kernel always occurs where hydrogen is focused, and the peak concentration of HO2 is aligned well with the scalar dissipation rate. The dependence of the ignition delay on turbulence intensity is found to be non-monotonic. For weak to moderate turbulence the ignition is facilitated by turbulence via enhanced mixing, while for stronger turbulence, whose timescale is substantially smaller than the ignition delay, the ignition is retarded due to excessive scalar dissipation, and hence diffusive loss, at the ignition location.
NTIS
Ignition; Turbulent Flow; Hydrogen; Mixing Layers (Fluids); Air Flow

19990039600 Department of Energy, Assistant Secretary for Energy Efficiency and Renewable Energy, Washington, DC USA
Convective heat transfer and flow stability in rotating disk CVD reactors
Winters, W. S., Department of Energy, USA; Evans, G. H., Department of Energy, USA; Greif, R., Department of Energy, USA;

Aug. 31, 1998; 8p; In English; 11th; Heat Transfer, USA
Report No.(s): DE98-052543; SAND-98-8482C; CONF-980806; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The flow and heat transfer of NH3 and He have been studied in a rotating disk system with applications to chemical vapor deposition (CVD) reactors. Influence of the important operating parameters were studied numerically over ranges of the primary dimensionless variables: (1) the spin Reynolds number, Re(sub omega), (2) the disk mixed convection parameter, MCP(sub d), and (3) a new parameter, the wall mixed convection parameter, MCP(sub w). Inlet velocities were set to the corresponding infinite rotating disk asymptotic velocity. Results were obtained primarily for NH3. Results show that increasing Re(sub omega) from 314.5 to 3,145 increases the uniformity of the rotating disk heat flux and results in thinner thermal boundary layers at the disk surface. At Re(sub omega) = 314.5, increasing MCP(sub d) to 15 leads to significant departure from the infinite disk result with nonuniform disk heat fluxes and recirculating flow patterns. At Re(sub omega) = 3,145, the results are closer to the infinite disk for MCP(sub d) up to 15. For large values of MCP(sub w), the flow recirculates and there is significant deviation from the infinite disk result. The influence of MCP(sub w) on flow stability is increased at larger MCP(sub d) and lower Re(sub omega). The results show that because of variable transport properties, the flow of NH3 is less stable than that of He as MCP(sub d) is increased for MCP(sub w) = 0 and Re(sub omega) = 314.5.
NTIS
Convective Heat Transfer; Flow Stability; Rotating Disks

19990039609 NASA Lewis Research Center, Cleveland, OH USA
Subparabolic Oxidation Behavior of Silicon Carbide at 1300 C
Ogbuji, Linjus U. J. T., NASA Lewis Research Center, USA; Journal of the Electrochemical Society; 1998; Volume 145, No. 8, pp. 2876-2882; In English; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

The phenomenon of subparabolic oxide growth rate, more the rule than the exception in the oxidation of silica formers, is examined in light of data sets acquired in SiC oxidation experiments at 1300 C. Negative deviation from parabolic kinetics is shown to correlate with oxide crystallinity. The data sets were analyzed to ascertain the predominant and contributing growth laws, and tested with models that describe the overall kinetics as combinations of the familiar growth laws.
Author
Oxidation; Growth; Silicon Carbides

19990039610 NASA Lewis Research Center, Cleveland, OH USA
Fundamentals of Passive Oxidation In SiC and Si3N4
Thomas-Ogbuji, Linus U., NASA Lewis Research Center, USA; 1998; In English; CIMTEC-9: World Ceramic Congress 1998, 14-19 Jun. 1998, Florence, Italy
Contract(s)/Grant(s): RTOP 523-21-13; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

The very slow oxidation kinetics of silicon carbide and silicon nitride, which derive from their adherent and passivating oxide films, has been explored at length in a broad series of studies utilizing thermogravimetric analysis, electron and optical micrography, energy dispersive spectrometry, x-ray diffractometry, micro-analytical depth profiling, etc. Some interesting microstructural phenomena accompanying the process of oxidation in the two materials will be presented. In Si3N4 the oxide is stratified, with an SiO2 topscale (which is relatively impervious to O2)underlain by a coherent subscale of silicon oxynitride which is even less permeable to O2- Such ”defence in depth” endows Si3N4 with what is perhaps the highest oxidation resistance of any material, and results in a unique set of oxidation processes. In SiC the oxidation reactions are much simpler, yet new issues still emerge; for instance, studies involving controlled devitrification of the amorphous silica scale confirmed that the oxidation rate of SiC drops by more than an order of magnitude when the oxide scale fully crystallizes.
Author
Oxidation; Silicon Carbides; Silicon Nitrides; Reaction Kinetics; Oxynitrides; Oxidation Resistance; Microstructure; Amorphous Materials; Crystallization

19990040174 Chemical Research and Development Center, Aberdeen Proving Ground, MD USA
Methanol Chemical Ionization Ion Trap Mass Spectrometry of VX Degradation Products ***Final Report, Nov. 1998***
Rohrbaugh, Dennis K., Chemical Research and Development Center, USA; March 1999; 55p; In English
Report No.(s): AD-A361469; CRDC-ECBC-TR-017; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

Mass spectrometric analysis of VX degradation products by electron ionization (EI) produces extensive fragmentation with little or no molecular ion information, making product identification difficult. Milder chemical ionization (CI) is commonly used to provide molecular weight and structure confirmation. In this study, methanol was used as a liquid CI reagent in combination

with an ion trap detector for detection and identification of over 30 compounds present in a thermally-degraded sample of VX. The use of the liquid reagent methanol provides superior results for this class of compounds with less fragmentation than commonly observed with gas reagents and offers logistical advantages for on-site analysis by being easier to transport and safer to use than gas cylinders: Ion trap EI and methanol CI mass spectra are provided as a reference for future identification of these compounds.
DTIC
Degradation; Chemical Reactions; Ionization; Mass Spectroscopy; Methyl Alcohol

19990040249 California Univ., Dept. of Materials Science and Engineering, Los Angeles, CA USA
Ostwald Ripening of Liquid and Solid ”Droplets” in Liquid Metal Matrices
Gan, H., California Univ., USA; Prikhodko, S., California Univ., USA; Ardell, A. J., California Univ., USA; NASA Microgravity Materials Science Conference; February 1999, pp. 45-50; In English; See also 19990040241; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

Ostwald ripening (coarsening) involves the growth of large particles at the expense of small ones in a polydisperse array. The driving force for coarsening is the reduction of interfacial area, hence energy, that accompanies growth as solute atoms are transported by diffusion from small to large particles. The theory of diffusion-controlled coarsening by Lifshitz and Slyozov and Wagner (the LSW theory) predicts that the average radius, <r>, of the particles in the minor (dispersed) phase increases with aging time, t, according to the familiar kinetic law <r>(exp 3) - <r(sub 0)>(exp 3) = kt, where <r(sub 0)> is the value of <r> at the onset of coarsening (t = 0) and k is a rate constant. There is always a small decrease in the residual supersaturation, X(sub alpha) - X(sub alpha(e)), with t during coarsening, where X(sub alpha) is the average solute concentration in the continuous (alpha) phase at t. and X(sub alpha(e)) is the solute concentration at thermodynamic equilibrium. X(sub alpha) - X(sub alpha(e)) obeys the asymptotic relationship X(sub alpha) - X(sub alpha(e)) proportional to (kappa(t))(exp -1/3) where kappa is another rate constant. The LSW theory was formulated for an infinitely dilute dispersion, i.e. one for which the volume fraction, f, is zero, strictly speaking. The theory must therefore be modified in some way to account for the fact that in any system in which f is finite there must be diffusional interactions, or overlapping diffusion fields, that affect the rate at which individual precipitates grow. Also, when f is large, physical encounters among the growing particles can become important. Considerable theoretical effort has been directed towards finding a quantitative solution to this problem. The differences among the theories and the extent to which they have succeeded in predicting the effect of f on coarsening behavior have been reviewed. Ostwald ripening has been intensively investigated in solid alloys in which the dispersed phase is coherent with the continuous phase. Coherency introduces the issues of the influence of elastic energy on the morphology of individual particles and spatial correlations among groups of precipitates. The motivation for investigating coarsening in liquid systems is that the underlying assumptions of the LSW theory are ideally fulfilled when the continuous phase is a liquid. In a liquid matrix the particles of the dispersed phase, be they liquid or solid, are usually spherical in shape, and both the continuous and dispersed phases are free of the internal stresses that complicate Ostwald ripening of coherent precipitates in solid systems. Furthermore, since all the theories predict that k(f) increases most rapidly with f when f is small (less than 0.05), quantitative evaluation of the different theories is, in principle, best accomplished by experiments on specimens containing relatively dilute dispersions. Microgravity is essential for successfully conducting experiments on liquid-based dispersions because differences between the mass densities of the continuous and droplet phases induce particle motion due to gravity-driven sedimentation forces. We believe we have succeeded in designing and constructing a novel furnace that fulfills the necessary objectives. It is, in principle, suitable for conducting experiments on coarsening of ”droplets” in liquid metals using a contactless method of measuring the change in electrical resistivity of the specimens during coarsening of the dispersed droplets. However, the circuitry necessary for successfully carrying out the experiments has not been satisfactorily built. It is not known at this stage whether it is possible to design and construct a Bridge circuit with the necessary sensitivity.
Derived from text
Ostwald Ripening; Drops (Liquids); Liquid Metals; Matrix Materials; Diffusion; Electrical Resistivity; Furnaces; Microstructure; Crystallization

19990040257 Illinois Univ., Dept. of Chemical Engineering, Chicago, IL USA
Combustion Synthesis of Titanium Nitride Under Fluidization
Brezinsky, Kenneth, Illinois Univ., USA; Lee, Kyeong-Ook, Illinois Univ., USA; Cohen, Jon J., Illinois Univ., USA; NASA Microgravity Materials Science Conference; February 1999, pp. 101-104; In English; See also 19990040241; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Several investigators have studied the self propagating high temperature synthesis (SHS) of titanium nitride during the past decade and found that one of the most important scientific issues is increasing the conversion yield of the nitride. In general, conversion yield has been limited by the melting of titanium particles during the combustion synthesis because the melting point of

titanium is lower than the combustion temperature. The titanium liquid tends to penetrate into interstitial spaces between the unreacted or unmelted particles especially in earth gravity leading to reduced reactant porosity. The reduction in porosity leads to less contact of nitrogen with the remaining titanium particles and low nitride conversion results. Recently, a technique was developed to increase the conversion yield of titanium nitride by using a fixed powder bed and supercritical nitrogen. The high initial nitrogen density at the supercritical condition provides the reactant particles with enough initial nitrogen that the conversion yield achieved was 74%, without significant formation of liquid barriers. The yield achieved was a significant improvement over those obtained by other techniques. Preliminary experimental results, future work, a schematic of the Fluidized-bed Dispersion/Combustion System, and micrographs of the morphologies of titanium nitride product and spherical titanium powder are presented.
Derived from text
Combustion Synthesis; Titanium Nitrides; Powder Metallurgy; Dispersions; Fluidized Bed Processors; Supercritical Fluids; Nitrogen

19990040325 Alabama Univ., Consortium for Materials Development in Space, Huntsville, AL USA
Reduction of Convection in Closed Tube Vapor Growth Experiments
Naumann, Robert J., Alabama Univ., USA; NASA Microgravity Materials Science Conference; February 1999, pp. 493-494; In English; See also 19990040241; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche; Abstract Only; Abstract Only

A novel method for suppressing convection during the solidification of material using closed tube physical or chemical vapor transport will be explored. Convection can be suppressed in growth from the melt by application of high magnetic fields but, unfortunately, this technique does not lend itself to vapors, which have no electrical conductivity. Since the Grashof number scales as the cube of the smallest dimension in the flow system, reduction of the size scale can be extremely effective in reducing unwanted convective flows. However, since materials of practical interest must be grown at least on the cm scale, reduction of the overall growth system is not feasible. But if the region just above the growing crystal could be restricted to a few mm, considerable reduction in flow velocity would result. by suspending an effusive barrier in the growth ampoule just above the growth interface, it should be possible to reduce the convective velocity in this vicinity to levels approaching flows in microgravity. The effusive barrier consists of a disc just slightly smaller than the growth ampoule inside diameter. The disc will be made of a porous material, such as a glass frit, that will allow the vapor to diffuse through, but will act as a barrier to direct flow. It will be positioned at a fixed distance above the growth interface by a series of small magnets imbedded at points around its periphery. The magnets will interact with magnets of opposite polarity placed in the furnace, just outside the growth ampoule. The furnace operating temperatures for most vapor or chemical vapor growth systems are well below the Curie temperature of most magnetic materials, so this should pose no problem. We will use a transparent furnace so that the growth front will be visible. The width of the region between the growth front and the barrier can then be monitored and adjusted if necessary by either adjusting the translation rate of the sample or by moving the magnets on the outside of the furnace. We will evaluate the effectiveness of the floating effusive barrier in vapor transport growth by growing single crystals of mercurous chloride. This choice was made for several reasons: (1) It is a technologically interesting acousto-optical material whose usefulness for device applications is still limited by structural defects that have been shown to be related to convection during the growth process by Singh and co-workers at the former Westinghouse Science and Technology Center (now Northrop-Grumman); (2) It is a relatively simple material to grow since it sublimes congruently and grows at low enough temperatures (approximately 400 C) so that a transparent furnace may be employed to monitor the growth process; (3) The material is brightly colored and optically clear at the growth temperature so that the growth interface is easily visible and gross defects can be detected and possibly corrected during the growth process; and (4) We, at the University of Alabama in Huntsville's Consortium for Materials Development in Space (UAH/CMDS), have had experience in growing this material though a previous cooperative agreement with the Westinghouse Science and Technology Center. Growth experiments will be carried out with different spacings between the effusive barrier and the growth interface, or the barrier may be moved during an individual growth run. Altering the barrier height changes the amount of convective flows and provides a means for assessing the effects of convection on the quality of the grown material. Characterization of the grown material will consist primarily of rocking curve data and optical scattering measurements since these are the properties that Dr. Singh and co-workers at Westinghouse found to be most affected by convection. Samples will also be submitted to the National Institute of Standards and Technology (NIST) for topographical analysis on their beam facility at the National Synchrotron Laboratory at Brookhaven. We also have a tentative agreement with the Brimrose Corporation in which they will evaluate the grown materials for potential device applications. If sufficient improvements result, this floating barrier method could be used as a screening experiment to determine if a proposed flight experiment that involves some form of vapor transport might benefit from a reduction in conduction. Also, the technique might be used to produce a new benchmark material against which future flight results might be judged. Finally, this new growth technique may lead to the production of improved materials on Earth as a microgravity program spin-off. After having

demonstrated improvements in the growth of single crystalline material on Earth, we intend to propose a flight experiment to see if additional improvements are possible by a further reduction in convective flows.
Author
Convection; Optical Properties; Vapor Deposition; Crystal Growth; Ampoules; Magnetic Fields; Melts (Crystal Growth); Single Crystals

19990040335 Orbital Technologies Corp., Space Center, Madison, WI USA
Carbon-Based Reduction of Lunar Regolith (CRLR)
Rice, Eric E., Orbital Technologies Corp., USA; NASA Microgravity Materials Science Conference; February 1999, pp. 553-554; In English; See also 19990040241; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

ORBITEC is developing a new high-temperature processing technique to produce oxygen and metals from Lunar regolith via carbonaceous high-temperature reduction. The utility in this technique overcomes problematic issues inherent in traditional high-temperature processing methods that employ crucible-type containment vessels and hot-walled (i.e., resistance or inductive) furnaces. Crucible containment structures either crack from thermal and mechanical stress and/or react with the molten reaction mix, making it very unlikely that such a material could survive the repeated high-temperature thermal cycling in an economical LOX plant on the Moon. to enable in situ production of Lunar oxygen, high-temperature reduction of Lunar soil can be accomplished using an alternate heating source, achieving high oxygen yield and high carbon (or hydrogen, depending on the reducing source) recovery. The proposed method will allow extremely high processing temperatures (>2000 C) and eliminate the difficult requirement of developing a containment vessel that withstands these temperatures, is impervious to prolonged chemical attack, and is capable of thermal cycling. Reduction of regolith using this heating approach will provide NASA with a manageable, practical, and efficient technique for extracting oxygen from indigenous Lunar resources for life support and propellant applications. In this effort, ORBITEC proposes to demonstrate new techniques for achieving high oxygen yield and high carbon or hydrogen recovery. It would also involve integrated designs for both a production plant and flight experiment, the latter being test-flown on a NASA reduced-gravity aircraft.
Derived from text
Regolith; High Temperature Environments; Oxygen Production; Lunar Resources; Space Processing; Space Manufacturing; Reduction (Chemistry); Heating; Carbon; Hydrogen

19990040343 Arizona Univ., Dept. of Aerospace and Mechanical Engineering, Tucson, AZ USA
The Effect of Doping on the Fracture Toughness of YSZ in a Low Oxygen Partial Pressure Environment
Sridhar, K. R., Arizona Univ., USA; Chen, W., Arizona Univ., USA; NASA Microgravity Materials Science Conference; February 1999, pp. 595-598; In English; See also 19990040241; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Solid oxide electrolyzers generate pure oxygen from oxygen bearing gases such as carbon dioxide, water, and air. These electrolyzers can generate oxygen from the carbon dioxide rich atmosphere of Mars, and also from the evolved gases obtained from hydrogen or carbon reduction of the lunar regolith. Several studies have shown that oxygen production from Martian atmosphere as a key technology that can reduce the cost of both robotic and human missions. There is a real need for developing better electrolyzer materials that offer superior thermal and mechanical characteristics as well as improved electrical performance. The electrolyte of the electrolyzer is a ceramic solid oxide such as yttria stabilized zirconia (YSZ). In order to develop structurally robust electrolyzers that would withstand the severe vibration and shock loads experienced during the launch and landing phases of the mission, it is essential to understand the damage initiation and consequent failure mechanisms and their relation to material composition and processing parameters. The objective of this research is to understand and quantify the relation between the loading/environmental conditions and the mechanical properties such as dynamic fracture toughness and dynamic bending strength and their relations to microstructures (thus processing parameters and choice of electrode and electrolyte compositions). In this project, we will investigate the effects of dopants on both the mechanical properties (fracture toughness, four-point and bi-axial bending strengths) and the electrical performance (oxygen conductivity) of YSZ in an environment with a low oxygen concentration.
Derived from text
Electrolysis; Fracture Strength; Mechanical Properties; Microstructure; Oxygen Production; Yttria-Stabilized Zirconia; Low Pressure; Additives

19990040353 Northwestern Univ., Dept. of Material Science and Engineering, Evanston, IL USA
Coarsening in Solid-Liquid Mixtures (CSLM)
Alkemper, J., Northwestern Univ., USA; Snyder, V., Northwestern Univ., USA; Voorhees, P. W., Northwestern Univ., USA; NASA Microgravity Materials Science Conference; February 1999, pp. 655-660; In English; See also 19990040241; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

The CSLM experiment examines the dynamics of particle-coarsening in a two-phase mixture. The evolution of the average particle size and particle size distribution of dispersed Sn-particles in a Pb-Sn liquid was measured with respect to time. Samples were heat treated at 185 C where a mixture of liquid Pb-Sn and Sn-rich solid exist with varying volume fractions of solid. Initially, the solid was present in the form of small, dispersed particles with average sizes of approx. 100 microns. Presented here are the results of the samples from the MSL-1 mission which have been analyzed at this time. Initially we concentrated our analysis on samples with 10% solid volume fraction, only a few samples with other volume fractions have been analyzed. It is found that the kinetics of the process follow the theoretical predictions within the uncertainties of the materials parameters. We also found an increasing coarsening rate with increasing volume fraction which is in agreement with existing theories. A full evaluation of the existing theories based on the results of the CSLM experiments is not possible at this point.
Author
Spaceborne Experiments; Space Processing; Microgravity; Particle Size Distribution; Solid Solutions; Microgravity Applications; Coarseness; Ostwald Ripening; Grain Size; Binary Mixtures; Liquid-Solid Interfaces

19990040397 NASA Langley Research Center, Hampton, VA USA
Pressure Broadening and Pressure Shift Coefficients in the 2nu(sup 0, sub 2) and nu(sub 1) Bands of (16)O(13)C(18)O
Devi, V. Malathy, College of William and Mary, USA; Benner, D. Chris, College of William and Mary, USA; Smith, Mary Ann H., NASA Langley Research Center, USA; Rinsland, Curtis P., NASA Langley Research Center, USA; Journal of Quantitative Spectroscopy and Radiative Transfer; 1998; ISSN 0022-4073; Volume 60, No. 5, pp. 771-783; In English; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

In this study we report the first measurements of the pressure broadening and the pressure-induced line shift coefficients due to air and nitrogen for 93 individual rovibrational lines, P(46) to R(46) and P(50) to R(45), respectively, belonging to the 2nu(sup 0, sub 2) and nu(sub 1) bands of (16)O(13)C(18)O. The results were obtained by analyzing ten long path, high-resolution laboratory, absorption spectra using a multispectrum nonlinear least-squares technique. Broadening due to nitrogen was about 4% larger than by air. Similar to broadening coefficients, the pressure-shift coefficients were found to be transition dependent, but different for the P- and R-branch lines with the same rotational quantum number, J. Except for a few R-branch lines, the measured shift coefficients were negative. The shift coefficients varied from + 4 x 10(exp -3)/cm.atm at 296 K to -5.6 x 10(exp -3)/cm.atm at 296 K. Comparisons of the broadening and shift coefficients between the two bands, between the P and R branches, and between the two broadening gases are reported. No significant difference between shift coefficients of the two bands or the two broadening gases was observed. The results obtained were compared with those reported in the literature for the more abundant (12)C(16)O2 species.
Author
Absorption Spectra; High Resolution; Pressure Broadening; Carbon Dioxide

19990040410 Florida Univ., Quantum Theory Project, Gainesville, FL USA
Proceedings of the International Symposium on Atomic, Molecular, and Condensed Matter Theory, Volume 70, No. 4/5
Final Report, 1 Oct. 1997 - 30 Sep. 1998
Loewdin, Per-Olov; Oehrn, Yngve; Sabin, John R.; Zerner, Michael C.; Feb. 1998; 570p; In English; Presented at the International Symposium on Atomic, Molecular, and Condensed Matter Theory on 21-27 Feb 98 at Ponce de leon Resort, St. Augustine, FL.
Contract(s)/Grant(s): N00014-98-1-0215
Report No.(s): AD-A361215; FLORIDA-TR-1; No Copyright; Avail: CASI; A24, Hardcopy; A04, Microfiche

The 38th Annual Sanibel Symposium, organized by the faculty, students, and staff of the Quantum Theory Project of the University of Florida, was held on February 21-27, 1998. Again, the Ponce de Leon Conference Center in St. Augustine, Florida, was the site of the gathering of more than 300 scientists. The symposium followed the established format with plenary and poster sessions. A compact 7-day integrated program of quantum biology, quantum chemistry, and condensed matter physics provided for intense and lively cross-disciplinary interactions. The topics of the sessions covered by these proceedings included Density Functional Theory (DFT) and Applications, Time-Dependent DFT, Femtosecond Dynamics, Dynamics of Electronically Excited States, Molecular Properties, Proton Transfer Dynamics, Methodological Developments in Quantum Chemistry, Relativistic Quantum Mechanics, Condensed Phase Chemistry, Hydrogen Bonding, and Molecular Properties in High Magnetic Fields. The articles have been subjected to the ordinary refereeing procedures of the International Journal of Quantum Chemistry. The articles presented in the sessions on quantum biology and associated poster sessions are published in a separate volume of the International Journal of Quantum Chemistry.
DTIC
Quantum Chemistry; Quantum Mechanics; Hydrogen Bonds; Quantum Theory; Protons

19990040537 Department of Energy, Office of Energy Research, Washington, DC USA

Studies in nonlinear problems of energy ***Final Report***

Matkowsky, B. J., Department of Energy, USA; Dec. 31, 1998; 17p; In English

Report No.(s): DE99-001021; DOE/ER/25027-T3; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The author completed a successful research program on Nonlinear Problems of Energy, with emphasis on combustion and flame propagation. A total of 183 papers associated with the grant has appeared in the literature, and the efforts have twice been recognized by DOE's Basic Science Division for Top Accomplishment. In the research program the author concentrated on modeling, analysis and computation of combustion phenomena, with particular emphasis on the transition from laminar to turbulent combustion. Thus he investigated the nonlinear dynamics and pattern formation in the successive stages of transition. He described the stability of combustion waves, and transitions to waves exhibiting progressively higher degrees of spatio-temporal complexity. Combustion waves are characterized by large activation energies, so that chemical reactions are significant only in thin layers, termed reaction zones. In the limit of infinite activation energy, the zones shrink to moving surfaces, termed fronts, which must be found during the course of the analysis, so that the problems are moving free boundary problems. The analytical studies were carried out for the limiting case with fronts, while the numerical studies were carried out for the case of finite, though large, activation energy. Accurate resolution of the solution in the reaction zone(s) is essential, otherwise false predictions of dynamical behavior are possible. Since the reaction zones move, and their location is not known a-priori, the author has developed adaptive pseudo-spectral methods, which have proven to be very useful for the accurate, efficient computation of solutions of combustion, and other, problems. The approach is based on a combination of analytical and numerical methods. The numerical computations built on and extended the information obtained analytically. Furthermore, the solutions obtained analytically served as benchmarks for testing the accuracy of the solutions determined computationally. Finally, the computational results suggested new analysis to be considered. A cumulative list of publications citing the grant make up the contents of this report.

NTIS

Mathematical Models; Flame Propagation; Laminar Flow; Boundary Value Problems; Turbulent Combustion; Combustion Physics; Free Boundaries

19990040640 Virginia Transportation Research Council, Charlottesville, VA USA

Corrosion Protection Performance Evaluation of Low Permeable Concretes in Exposure Specimens ***Final Report***

Zemajtis, J.; Weyers, R. E.; Sprinkel, M. M.; Jan. 1999; 154p; In English

Report No.(s): PB99-130627; VTRC-99-CR5; Copyright; Avail: National Technical Information Service (NTIS), Microfiche

The application of a mineral admixture or a combination of a mineral admixture with corrosion inhibitor are the methods used for the corrosion protection for reinforced concrete Bridges. The results of a 1.5-year study on evaluation of three concretes with fly ash, slag cement (SC), and silica fume (SF) and one concrete with silica fume and a corrosion inhibitor (SFD) are presented. The specimens were built to simulate four exposure conditions typical for concrete Bridges located in the coastal region or inland where deicing salts are used. The exposure conditions were horizontal, vertical, tidal, and immersed zones. The specimens were kept inside the laboratory and were exposed to weekly ponding cycles of 6% sodium chloride solution by weight. In addition, cover depth measurements from 21 Bridge decks and chloride data from 3 Bridge decks were used, together with laboratory data, in modeling the service lives of investigated corrosion protection methods.

NTIS

Corrosion Prevention; Bridges (Structures)

19990040965 Florida Univ., Quantum Theory Project, Gainesville, FL USA

Proceedings of the International Symposium on the Application of Fundamental Theory to Problems of Biology and Pharmacology, Volume 70 No. 6 ***Final Report, 1 Oct. 1997 - 30 Sep. 1998***

Ohrn, Yngve; Mar. 23, 1999; 159p; In English

Contract(s)/Grant(s): N00014-98-1-0215

Report No.(s): AD-A361183; ONR-TR-1; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche

The 38th Annual Sanibel Symposium, organized by the faculty and staff of the Quantum Theory Project of the University of Florida, was held on February 21-27, 1998. This year, the Ponce de Leon Conference Center in St. Augustine, Florida, was the site of the gathering of more than 300 scientists. The symposium followed the established format with plenary and poster sessions. A compact 7-day integrated program of quantum biology, quantum chemistry, and condensed matter physics was presented. The topics of the sessions covered by these proceedings included Spectroscopy of Base Pairs, Quantum/Classical Molecular Mechanics, Simulations of Biological Systems, Metals in Biology, and Linear Scaling.

DTIC

Quantum Chemistry; Quantum Theory; Condensed Matter Physics; Quantum Mechanics

26
METALLIC MATERIALS

Includes physical, chemical, and mechanical properties of metals, e.g., corrosion; and metallurgy.

19990038366 Department of Energy, Washington, DC USA
Mechanical and metallographic characterization of LIGA fabricated nickel and 80%Ni-20%Fe Permalloy
Christenson, T. R., Department of Energy, USA; Buchheit, T. E., Department of Energy, USA; Schmale, D. T., Department of Energy, USA; Bourcier, R. J., Department of Energy, USA; Apr. 13, 1998; 8p; In English
Report No.(s): DE98-004682; SAND-98-0906C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

A table top servohydraulic load frame equipped with a laser displacement measurement system was constructed for the mechanical characterization of LIGA fabricated electroforms. A drop in tensile specimen geometry which includes a pattern to identify gauge length via laser scanning has proven to provide a convenient means to monitor and characterize mechanical property variations arising during processing. In addition to tensile properties, hardness and metallurgical data were obtained for nickel deposit specimens of current density varying between 20 and 80 mA/cm(exp 2) from a sulfamate based bath. Data from 80/20 nickel-iron deposits is also presented for comparison. As expected, substantial mechanical property differences from bulk metal properties are observed as well as a dependence of material strength on current density which is supported by grain size variation. While elastic modulus values of the nickel electrodeposit are near 160 GPa, yield stress values vary by over 60%. A strong orientation in the metal electrodeposits as well as variations in nucleating and growth morphology present a concern for anisotropic and geometry dependent mechanical properties within and between different LIGA components.
NTIS
Metallography; Fabrication; Nickel; Permalloys (Trademark); Iron

19990038368 Department of Energy, Assistant Secretary for Management and Administration, Washington, DC USA
Fracture toughness testing and toughening mechanisms of some commercial cobalt-free hardfacing alloys
Cockeram, B. V., Department of Energy, USA; Apr. 27, 1998; 19p; In English; Thin Films (TSF) and Surface and Coatings Technology (SCT), USA; Sponsored by American Vacuum Society, USA
Report No.(s): DE98-004680; WAPD-T-3177; CONF-980429; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Hardfacing alloys are weld deposited to provide a wear resistant surface for structural base materials. Commercial low cobalt hardfacing alloys are being evaluated to reduce plant activation levels. Since hardfacing alloys typically must be resistant to cracking to assure adequate in service performance, fracture toughness is a critical material property. Fracture toughness (K(sub IC)) measurements of Fe base, Ni-base, and Co-base hardfacing were performed in accordance with ASTM E399-90 procedure in an effort to identify a tough cobalt-free alternative. Reduced scatter in K(sub IC) data was observed for the Fe base hardfacing, and the 95% lower bound K(sub IC) values were generally higher than the Ni-base Hardfacing alloys. Preliminary crack growth data obtained during precracking indicate that the Ni-base hardfacing possess better fatigue crack growth resistance. However, none of the Fe-base or Ni-base hardfacing have K(sub IC) values that are comparable to the reference Co-base hardfacing. The test specimens were machined from thick (0.5 inches) weld deposits, and the microstructures of the test specimens are compared with the more prototypic, thinner deposits. Microstructural and fractographic examinations are used to characterize the fracture mechanisms and delineate the operative toughening mechanisms. Crack deflection and crack bridging toughening mechanisms are shown to be relevant for most of the commercial hardfacing.
NTIS
Fracture Strength; Cobalt Alloys; Reactor Materials

19990038371 Department of Energy, Office of Energy Research, Washington, DC USA
Solidification process in melt spun Nd-Fe-B type magnets
Li, C., Department of Energy, USA; Feb. 23, 1998; 91p; In English
Report No.(s): DE98-004653; IS-T-1833; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

A generalized solidification model has been developed based on a systematic investigation on the microstructure of melt spun Nd-Fe-B alloys. Melt spinning was conducted on initial stoichiometric and TiC added Nd2Fe14B(2-14-1) compositions to produce under, optimally and over quenched microstructures. Microstructural characterization was carried out by Transmission Electron Microscopy (TEM), Scanning Electron Microscopy (SEM), Optical microscopy, XRD, DTA, VSM and DC SQUID techniques. by taking the dendritic breakup during recalescence into consideration, this generalized model has successfully explained the solidification process of the melt spun Nd-Fe-B alloys. Challenging the conventional homogeneous nucleation models, the new model explains the fine and uniform equiaxed 2-14-1 microstructure in optimally quenched ribbons as a result of the

breakup of the 2-14-1 dendrites which nucleate heterogeneously from the wheel surface and grow dendritically across the ribbon thickness due to the recalescence. Besides this dendritic breakup feature, the under quenched microstructure is further featured with another growth front starting with the primary solidification of Fe phase near the free side, which results in a coarsely grained microstructure with Fe dendritic inclusions and overall variation in microstructure across the ribbon thickness. In addition, because a epitaxy exists between the Fe phase and the 2-14-1, the so-formed coarse 2-14-1 grains may be textured. C-axis texturing was observed in under quenched ribbons. As a constraint to solidification models in this system, the cause and characteristics of this phenomenon has been studied in detail to test the authors proposed model, and agreement has been found. An extension has also been made to understand the solidification process when TiC is added, which suggests that Ti and C slow down the growth front of both Fe and 2-14-1 phase.
NTIS
Solidification; Melt Spinning; Neodymium Alloys; Boron Alloys; Magnets; Iron Alloys

19990038382 Department of Energy, Office of Energy Research, Washington, DC USA
Solidification analysis of a centrifugal atomizer using the Al-32.7wt.% Cu alloy
Osborne, M. G., Department of Energy, USA; Feb. 23, 1998; 117p; In English
Report No.(s): DE98-004642; IS-T-1831; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

A centrifugal atomizer (spinning disk variety) was designed and constructed for the production of spherical metal powders, 100--1,000 microns in diameter in an inert atmosphere. Initial atomization experiments revealed the need for a better understanding of how the liquid metal was atomized and how the liquid droplets solidified. to investigate particle atomization, Ag was atomized in air and the process recorded on high-speed film. to investigate particle solidification, Al-32.7 wt.% Cu was atomized under inert atmosphere and the subsequent particles were examined microscopically to determine solidification structure and rate. This dissertation details the experimental procedures used in producing the Al-Cu eutectic alloy particles, examination of the particle microstructures, and determination of the solidification characteristics (e.g., solidification rate) of various phases. Finally, correlations are proposed between the operation of the centrifugal atomizer and the observed solidification spacings.
NTIS
Solidification; Centrifugal Force; Atomizers; Aluminum Alloys; Copper Alloys

19990039139 Department of Energy, Assistant Secretary for Nuclear Energy, Washington, DC USA
High temperature materials technology research for advanced thermionic systems ***Final Report***
Zee, R. H., Department of Energy, USA; Rose, M. F., Department of Energy, USA; Dec. 31, 1998; 126p; In English
Report No.(s): DE98-007450; DOE/SF/19645-T12; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Tungsten and tungsten alloys are candidate materials for the thermionic emitter in the space nuclear power convertor. In this work, the creep behavior of HfC strengthened tungsten alloys was studied. An ultrahigh vacuum, high precision creep test system was constructed for this purpose so that the samples could be heated up to 3,000 K for heat treatment and creep strain could be measured from the creep sample inside the UHV chamber. to explain the creep behavior observed in this dispersion strengthened alloy, a creep model was proposed which accounted for the presence of HfC particles in the form of a back stress generated by these particles. This model was verified by the creep test data of W-0.37 HfC alloys tested under both extruded and recrystallized microstructural conditions. According to this model, the steady state creep of this type of alloys was expected to increase with time due to coarsening of HfC particle and recrystallization of the alloys under high temperatures. In contrast, conventional simple power law creep model only predicts a constant steady state creep for these materials, which does not represent the microstructural evolution of the materials. The creep of solid solution alloys such as W-Re, W-Nb and W-Hf and Mo-Nb was also studied. These materials are expected to be more stable in creep properties due to the absence of coarsening particles. These solid solution alloys, in their single crystalline state, are reported possessing better corrosion resistance over their polycrystalline counterparts. Existing creep data of both solid solution tungsten and molybdenum alloys were re-analyzed. The data of these alloys showed two distinct different creep mechanisms: Class I and Class II. The dominating creep mechanism at low stresses could be explained by the Takuchi-Argon model (Class I). At higher stresses, the data could not be explained by any of the existing creep models. A creep model was thus proposed that contained a shift factor due to the effect of the solute in these alloys. In this model, the Class II creep behavior of these solution alloys were found as a function of the alloy concentration and atomic size mismatch.
NTIS
Tungsten Alloys; Creep Tests; Refractory Materials; Creep Properties; Thermionic Emitters; Tungsten

19990039180 General Electric Co., Advanced Engineering Technologies Dept., Cincinnati, OH USA

Thin Dense Chrome Bearing Insertion Program; Pyrowear 675 and Cronidur Wear Testing ***Final Report, 1 Dec. 1996 - 1 Aug. 1998***

Johnson, Michael; Laritz, John; Rhoads, Mark; Oct. 1998; 59p; In English

Contract(s)/Grant(s): F33615-92-C-2208; AF Proj. 3048

Report No.(s): AD-A361451; R98AEB240; AFRL-PR-WP-TR-1998-2110; No Copyright; Avail: Issuing Activity (Defense Technical Information Center (DTIC)), Microfiche

This portion of the Thin Dense Chrome Insertion Program evaluated two new corrosion-resistant materials for use in F101 and F110 main shaft bearings: Cronidur 30 and Pyrowear 675. Contamination, wear, and corrosion resistance were assessed through selected subscale and full-scale tests. Subscale tests evaluated the wear characteristics and corrosion resistance. Full-scale tests demonstrated contamination resistance at normal F110-GE-129 operating conditions with exposure to abnormal aluminum oxide contamination levels. Cronidur 30 demonstrated improved corrosion resistance relative to M50 in salt water and tap water in subscale corrosion testing. Pyrowear 675 also demonstrated improved corrosion resistance relative to M50 but was not as good as Cronidur 30. Both Cronidur 30 and Pyrowear 675 demonstrated reduced wear resistance relative to M50 material in subscale testing. In full-scale testing, both materials exhibited outer race shoulder and cage pocket wear greater than M50. Based on these results, both new bearing materials were deemed to be too great of risk for immediate application to the F101 and F110 engines. Possibly, bearing alloy development or race treatments can be used to improve wear resistance, but such assessment was beyond the scope of this contract.

DTIC

Chromium; Bearing Alloys; Wear Resistance

19990039214 Department of Energy, Assistant Secretary for Fossil Energy, Washington, DC USA

Fireside corrosion testing of candidate superheater tube alloys, coatings, and cladding, Phase 2, Field Testing

Blough, J. L., Department of Energy, USA; Seitz, W. W., Department of Energy, USA; Girshik, A., Department of Energy, USA; Jun. 30, 1998; 75p; In English

Report No.(s): DE98-006098; ORNL/SUB-93-SM401/02; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

In Phase 1 of this project, laboratory experiments were performed on a variety of developmental and commercial tubing alloys and claddings by exposing them to fireside corrosion tests which simulated a superheater or reheater in a coal-fired boiler. Phase 2 (in situ testing) has exposed samples of 347, RA85H, HR3C, RA253MA, Fe3Al + 5Cr, Ta-modified 310, NF 709, 690 clad, 671 clad, and 800HT for up to approximately 16,000 hours to the actual operating conditions of a 250-MW, coal-fired boiler. The samples were installed on air-cooled, retractable corrosion probes, installed in the reheater cavity, and controlled to the operating metal temperatures of an existing and advanced- cycle, coal-fired boiler. Samples of each alloy were exposed for 4,483, 11,348, and 15,883 hours of operation. The present results are for the metallurgical examination of the corrosion probe samples after the full 15,883 hours of exposure. A previous topical report has been issued for the 4,483 hours of exposure.

NTIS

Boilers; Corrosion Tests; Pipes (Tubes); Cladding; Coatings; Corrosion Resistance; Stainless Steels; Heating Equipment

19990039552 Naval Surface Warfare Center, Carderock Div., Bethesda, MD USA

Round Robin Damping Testing on Nonlinear Material

Graesser, Edward J.; Wong, Catherine R.; Kinra, Vikram; Friend, Danner; Lavernia, Enrique; Dec. 1998; 70p; In English

Report No.(s): AD-A361404; NSWCCD-TR-1998/026; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

In order to assess the state of the art in damping measurements of metals, a round-robin series of damping tests was conducted. Two steels were employed in the work. One had high but nonlinear damping properties. The other was a high strength US Navy steel that had low damping properties. In this report, specimen damping test results are presented and compared. In addition, a procedure for converting from specimen damping to intrinsic damping is employed, and results are also presented on this basis. Furthermore, some test participants were able to measure the elastic modulus of the material while measuring damping, and this is also presented and discussed. It is clear from the work that large measured differences in both specimen and intrinsic damping can result when different test methods are employed. The differences are primarily attributed to systematic errors in certain testing procedures and sample design and size. In addition the method of loading and type of measurement may also account for some of the differences. A supported effort to establish a standard test sample and a standardized measurement approach is recommended to advance the state of the art in this field.

DTIC

Damping; Alloys; High Strength Steels; Nonlinearity; Damping Tests

19990039570 Department of Energy, Washington, DC USA

Texture evolution in upset-forged P/M and wrought tantalum: Experimentation and modeling

Bingert, J. F., Department of Energy, USA; Desch, P. B., Department of Energy, USA; Bingert, S. R., Department of Energy, USA; Maudlin, P. J., Department of Energy, USA; Tome, C. N., Department of Energy, USA; Nov. 30, 1997; 13p; In English; Tungsten, Refractory Metals and Alloys, 1997, USA

Report No.(s): DE98-002924; LA-UR-97-4469; CONF-971168; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Preferred orientations in polycrystalline materials can significantly affect their physical and mechanical response through the retention of anisotropic properties inherent to the single crystal. In this study the texture evolution in upset-forged P/M and wrought tantalum was measured as a function of initial texture, compressive strain, and relative position in the pressing. A &less than;001& amp;amp;greater than;/& amp;less than;111&greater than; duplex fiber texture parallel to the compression axis was generally observed, with varying degrees of a radial component evident in the wrought material. The development of deformation textures derives from restricted crystallographic slip conditions that generate lattice rotations, and these grain reorientations can be modeled as a function of the prescribed deformation gradient. Texture development was simulated for equivalent deformations using both a modified Taylor approach and a viscoplastic self-consistent (VPSC) model. A comparison between the predicted evolution and experimental results shows a good correlation with the texture components, but an overly sharp prediction at large strains from both the Taylor and VPSC models.

NTIS

Tantalum; Experimentation; Models; Polycrystals; Research; Crystallography; Textures; Viscoplasticity

19990039580 Department of Energy, Office of Energy Research, Washington, DC USA

Extrinsic Curie temperature and spin reorientation changes in Nd2 Fe14B/(alpha)-Fe nanocomposites

Lewis, L. H., Department of Energy, USA; Panchanathan, V., Department of Energy, USA; May 31, 1998; 12p; In English; 10th; 15th; Rare-earth Magnets and their Applications, USA, USA, USA

Report No.(s): DE98-005715; BNL-65211; CONF-980802; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The Curie temperatures and spin reorientation temperatures of a series of four melt-spun nanocomposite materials comprised of Nd2Fe14B and varying amounts of (alpha)-Fe were measured using independent techniques. The phase constitution and grain size was assessed with synchrotron x-ray diffraction; the Curie temperatures were measured by differential thermal analysis (DTA) and dc SQUID magnetometry in the temperature range 375 K (le) T (le) 800 K, whereas the spin reorientation transition temperature was determined from ac susceptibility measurements taken in the range 10 K (le) T (le) 300 K. The Curie temperature increases with increasing excess iron content, resulting in a 18 (degree) enhancement over the Curie temperature of pure Nd(sub 2)Fe(sub 14)B for 27 wt% excess (alpha)-Fe. The spin reorientation temperatures are depressed from the single-crystal value by an average of 10 degrees. Both anomalous effects are attributed to intergranular exchange coupling present in the alloys, although the effects of uncompensated stress between the constituent phases cannot be ruled out The experimental results suggest that while the Curie temperature of the Nd(sub 2)Fe(sub 14)B phase may be extrinsically enhanced significantly beyond the bulk value, possibly extending the range of applications of this compound, the anisotropy may be simultaneously lowered, impeding the attainment of high coercivities in these alloys.

NTIS

Spin Temperature; Neodymium Alloys; Transition Temperature; Magnetic Measurement; Augmentation; Anisotropy; Curie Temperature; Spin Dynamics

19990039623 Department of Energy, Washington, DC USA

Analysis of the e-beam evaporation of titanium and Ti-6Al-4V

Westerberg, K. W., Department of Energy, USA; Merier, T. C., Department of Energy, USA; McClelland, M. A., Department of Energy, USA; Braun, D. G., Department of Energy, USA; Berzins, L. V., Department of Energy, USA; Feb. 11, 1998; 16p; In English; Electron Beam Melting and Refining State of the Art, 1997, USA

Report No.(s): DE98-057760; UCRL-JC-128692; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

An experimental and finite element analysis was performed for the electron-beam evaporation of Ti and Ti-6Al-4V from a bottom-feed system. The bulk evaporation rate was measured by feed consumption, and the pool elevation was held constant by adjusting the feed rate in a closed-loop control system. The instantaneous titanium and aluminum evaporation rates were determined by laser absorption in the vapor plume. Water temperature rises in cooling water circuits provided heat flows, and post-run cross sections revealed the location of the solidification zone. The MELT finite element code was applied to model the steady-state two-dimensional fluid flow and energy transport in the rod. There was good agreement between model and measured values of

the heat flows and solidification boundaries for Ti. Measured bulk evaporation rates were similar for Ti and Ti-6-4 with greater variation observed for the Ti values. The model evaporation rates were higher than the measured values, but a similar linear dependence on e-beam power was observed in all cases. In a Ti-6-4 evaporation experiment with steady process conditions, laser absorption measurements showed much larger fluctuations in the evaporation rate for Al than Ti.
NTIS
Titanium; Electron Beams; Titanium Alloys; Finite Element Method; Absorption Spectroscopy; Aluminum Alloys; Vanadium Alloys; Evaporation; Fluid Flow

19990040163 Department of Energy, Washington, DC USA
Thickness dependencies in the calculated properties of metallic ultra-thin films
Boettger, J. C., Department of Energy, USA; Dec. 31, 1997; 24p; In English; Sponsored by Materials Research Society, USA
Report No.(s): DE98-002934; LA-UR-97-4759; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Ultra-thin film (UTF) electronic structure calculations are a common tool for investigating surface properties. For this approximation to be useful, the UTF must be thick enough that the surfaces are decoupled and the interior is bulk-like, yet thin enough that a high precision electronic structure calculation is affordable. These conditions can only be satisfied simultaneously if the properties of interest converge rapidly as the UTF thickness is increased. In this work, electronic structure calculations for Al(111) films ranging from one to twelve atoms thick are used to illustrate some of the difficulties that can arise when one attempts to determine surface properties of metals with UTF calculations.
NTIS
Thin Films; Thickness; Metal Films; Aluminum; Computation

19990040251 Alabama Univ., Center for Microgravity and Materials Research, Huntsville, AL USA
Thermophysical Property Measurements of Te-Based II-VI Semiconductors
Banish, R. Michael, Alabama Univ., USA; Alexander, J. Iwan D., Case Western Reserve Univ., USA; NASA Microgravity Materials Science Conference; February 1999, pp. 57-62; In English; See also 19990040241; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

The experimental determination of transport properties such as diffusivities and conductivities is often contaminated by buoyancy-driven convective effects. The accurate determination of transport properties requires convective flow velocities to be eliminated or significantly suppressed. This is generally not possible under terrestrial conditions. While it can be argued that mass diffusivity measurement techniques such as nuclear magnetic resonance and inelastic neutron scattering, that probe rapid molecular motion, are insensitive to convective contributions, they are not as precise as macroscopic, averaging techniques. However, all macroscopic measurement techniques yield diffusivity data prone to be contaminated by gravity-driven convection. The use of narrow capillaries to suppress convective transport has suggested poorly understood wall effects. Magnetic fields, widely used for suppressing convection in conducting liquids, modify the diffusive motion itself. Earlier liquid (metal) diffusion studies conducted on spacecraft have demonstrated the gain in precision resulting from the drastic reduction of convection in low-gravity environments. Simple scaling illustrates the difficulty of obtaining purely diffusive transport in liquids. In a system of diffusivity 10(exp -5)sq cm/s and a typical diffusion distance of 1 cm, the characteristic diffusion velocity is of order 10(exp -5)sq cm/s. Hence, if true diffusion is to be observed, convective flow velocities parallel to the concentration gradient must be of order 10(exp -7) cm/s, i.e. 10 Angstroms/s, or less! Thus, in liquids, the attainment of diffusion-dominated transport over macroscopic distances at normal gravity is obviously not a simple task. This is illustrated by modelling results for diffusive-convective transport in capillaries with realistic thermal boundary conditions, which indicate that temperature nonuniformities as low as 0.1K, across samples of mm dimensions, are sufficient to cause convective domination of transport. Numerical modelling results from our research indicate that at the high magnetic fields necessary to decrease the convective flow velocity of 1% of the diffusive velocity, a similar, significant influence on the diffusive motion will occur. Thermal diffusivity measurements in melts are also prone to be contaminated by convective contributions. The use of small measuring volumes increases the likelihood that asymmetries and imperfections in the measurement apparatus itself leads to errors. The use of larger cell volumes on the other hand is prone to result in convective contamination. These problems can be especially troublesome with II-VI semiconductors, since their thermal conductivity is smaller than that of typical container materials. Levitated drop techniques offer little relief of this problem due to the high vapor pressure of II-VI compounds. Modelling of these convective contributions is at best problematic since the assumptions for estimating or modelling these contributions depends on ground-based data already influenced by convection. The above analysis can be applied to thermal diffusivity and/or conductivity measurements as well, although the requirements are not quite as stringent as for mass diffusivity. Assuming a thermal conductivity of 0.0108 W-cm/K (CdTe) the melt thermal diffusivity is 0.010 sq cm/s. Then for a 1 cm cell, convective velocities need to be less than 0.0001 cm/sec to obtain precise thermal diffusivity values. Earlier liquid thermal conductivity/diffusivity studies conducted on spacecraft have demonstrated the gain in precision, and lower

absolute values, resulting from the drastic reduction of convection in a low-gravity environments. Diffusivity and thermophysical properties for the tellurium based II-VI binary semiconductors (CdTe, HgTe and ZnTe) have been studied quite extensively in the solid state. However, for the molten state only few values exist, and the temperature dependence is practically unknown. We will extend our presently employed ”novel” diffusivity technique to the measurement of binary- and (selected) impurity- diffusivity in melts of Te-based II-VI compounds over a temperature range approximately 100 C above the melting point. In addition, we will measure the following interrelated thermophysical parameters: (1) density change on melting and the volume expansion coefficient of the melt for pure and doped materials; and (2) melt thermal conductivity and thermal diffusivity.
Derived from text
Semiconductors (Materials); Thermal Diffusivity; Thermal Conductivity; Melts (Crystal Growth); Temperature Dependence; Transport Properties; Convective Flow; Tellurium Alloys

19990040266 Illinois Univ. at Urbana-Champaign, Dept. of Mechanical and Industrial Engineering, Urbana, IL USA
Adaptive-Grid Methods for Phase Field Models of Microstructure Development
Provatas, Nikolas, Illinois Univ. at Urbana-Champaign, USA; Goldenfeld, Nigel, Illinois Univ. at Urbana-Champaign, USA; Dantzig, Jonathan A., Illinois Univ. at Urbana-Champaign, USA; NASA Microgravity Materials Science Conference; February 1999, pp. 147-152; In English; See also 19990040241
Contract(s)/Grant(s): NAG8-1249; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

In this work the authors show how the phase field model can be solved in a computationally efficient manner that opens a new large-scale simulational window on solidification physics. Our method uses a finite element, adaptive-grid formulation, and exploits the fact that the phase and temperature fields vary significantly only near the interface. We illustrate how our method allows efficient simulation of phase-field models in very large systems, and verify the predictions of solvability theory at intermediate undercooling. We then present new results at low undercoolings that suggest that solvability theory may not give the correct tip speed in that regime. We model solidification using the phase-field model used by Karma and Rappel.
Derived from text
Computational Grids; Microstructure; Finite Element Method; Solidification; Computerized Simulation; Phase Transformations; Liquid-Solid Interfaces; Dendritic Crystals

19990040278 Massachusetts Inst. of Tech., Dept. of Materials Science and Engineering, CamBridge, MA USA
Alloy Undercooling Experiments in a Microgravity Environment: Recent Results From the STS-83 and STS-94 Missions
Flemings, Merton C., Massachusetts Inst. of Tech., USA; Matson, Douglas M., Massachusetts Inst. of Tech., USA; NASA Microgravity Materials Science Conference; February 1999, pp. 213-218; In English; See also 19990040241; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

The focus of this program is the study of the effect of microgravity on metastable solidification of ternary steel alloys. by observing changes in the mechanism for nucleation of the stable phase following primary recalescence from undercooled melts, the role of convection in phase selection may be evaluated. Double recalescence events were observed in hypoeutectic ternary steel alloys at much lower undercoolings than previously reported. Using a high speed imaging technique, we are able to identify and characterize the mechanism for nucleation of the stable phase after the initiation of metastable phase growth. We have shown evidence that nucleation of the stable phase at the interface between the growing metastable phase and the liquid may be suppressed in microgravity. When comparing the growth rate under ground-based and microgravity conditions, there is no significant difference for the observed growth of the metastable phase into the undercooled liquid over the range of undercoolings investigated. There is also no significant difference in the growth rate of the stable phase into the semi-solid that formed during primary recalescence. There is, however, a significant difference in the delay between primary and secondary recalescence. We have successfully developed a model that combines: (1) simultaneous growth of competing phases, (2) the delay between recalescence events, (3) assumptions on the mechanism for secondary nucleation of the stable phase, and (4) given a known relationship between the sensor and the nucleation events to explain the role of growth competition in phase selection during rapid solidification of undercooled hypoeutectic Fe-Cr-Ni alloys. Using this model we have demonstrated that a difference exists between the high convective environment of ground based electromagnetic levitation and that attainable in microgravity.
Derived from text
Spaceborne Experiments; Space Processing; Microgravity; Gravitational Effects; Supercooling; Containerless Melts; Nucleation

19990040292 Rice Univ., Dept. of Electrical and Computer Engineering, Houston, TX USA

Optical Resonances of Gold Nanoshells

Averitt, R. D., Rice Univ., USA; Oldenburg, S. J., Rice Univ., USA; Westcott, S. L., Rice Univ., USA; Lee, T. R., Houston Univ., USA; Halas, N. J., Rice Univ., USA; NASA Microgravity Materials Science Conference; February 1999, pp. 301-306; In English; See also 19990040241; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

Metal nanoshells, consisting of a dielectric core with a metallic shell of nanometer thickness, are a new, composite nanoparticle whose optical resonance can be ”designed in” in a controlled manner. by varying the relative dimensions of the core and shell, the optical resonance of these nanoparticles can be varied over hundreds of nanometers in wavelength, across the visible and into the infrared region of the spectrum. These nanoparticles can serve as constituents in a new class of materials that are capable of uniquely controlling radiation in the visible and infrared spectral regions. Our current research focuses on two types of nanoshells: naturally occurring gold-coated Au2S nanoshells and gold-coated silica nanoparticles that are formed utilizing colloid reduction chemistry and self-assembly.

Derived from text

Dielectrics; Gold; Optical Resonance; Gold Coatings; Nanostructure (Characteristics); Gravitational Effects; Thin Films; Nanocrystals; Crystallization

19990040316 National Inst. of Standards and Technology, Metallurgy Div., Gaithersburg, MD USA

Thermophysical Properties of High Temperature Liquid Metals and Alloys

Manning, John, National Inst. of Standards and Technology, USA; Krishnan, Shankar, Containerless Research, Inc., USA; NASA Microgravity Materials Science Conference; February 1999, pp. 437-442; In English; See also 19990040241; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

The objective of this research is to extend, for the first time, the laser polarimetry technique for measuring the normal spectral emissivity to the microsecond time regime. This will enable accurate determination of true temperature of liquid specimens at high temperatures in rapid pulse heating experiments. In addition to the measurement of other experimental quantities, the proposed project will yield data on selected thermophysical properties with unsurpassed accuracy that can be used in support of microgravity materials science research. The properties to be measured include enthalpy, specific heat capacity, heat of fusion, and electrical resistivity above the melting point of selected refractory metals and alloys.

Derived from text

Liquid Metals; Alloys; Thermophysical Properties; Polarimetry; Laser Applications; Spectral Emission; Temperature Measurement

19990040330 Arizona Univ., Dept. of Materials Science and Engineering, Tucson, AZ USA

Comparison of Structure and Segregation in Alloys Directionally Solidified in Terrestrial and Microgravity Environments

Poirier, D. R., Arizona Univ., USA; Tewari, S. N., Cleveland State Univ., USA; Heinrich, J. C., Arizona Univ., USA; NASA Microgravity Materials Science Conference; February 1999, pp. 521-526; In English; See also 19990040241; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

Efforts have been on establishing the science base for directional solidification in low gravity. The primary purpose is to compare the structure and segregation in a binary alloy that is directionally solidified in terrestrial and low gravity environments. Models of dendritic solidification that are used to predict microstructural features upon solidification rely on the assumption of only diffusional transports. However, the thermosolutal convection masks the diffusional processes at the dendrite tips and is also responsible for macrosegregation in directionally solidified castings. Availability of microgravity provides an opportunity to obtain experimental data, where thermosolutal convection and attendant macrosegregation are negligible. This is a program to conduct experiments in a long-duration microgravity environment, with the objective of studying dendritic microstructures and segregation in directionally solidified dendritic alloys. The research is based on directionally solidified Pb-Sb alloys and simulations of solidification of the alloys using continuum theory of porous media. Since thermosolutal convection strongly affects transport phenomena during solidification and also leads to macrosegregates, we are convinced, therefore, that experiments in microgravity would enable us to gain scientific data on dendritic microstructures solidified without thermosolutal convection. We will characterize dendrite arm spacings, volume fraction of interdendritic liquid, and both macrosegregation and microsegregation in samples that are solidified in microgravity. The design of the microgravity experiments is guided by our on-going terrestrial experiments and computer simulations, which are being done to identify suitable growth conditions and the effect of g-jitter in microgravity experiments.

Derived from text

Transport Properties; Solidification; Microstructure; Microgravity; Convection; Directional Solidification (Crystals); Gravitational Effects; Binary Alloys; Crystallization; Dendritic Crystals; Spaceborne Experiments; Space Processing

19990040344 NASA Marshall Space Flight Center, Huntsville, AL USA

Particle Engulfment and Pushing by Solidifying Interfaces

Stefanescu, Doru M., Alabama Univ., USA; Juretzko, Frank R., Alabama Univ., USA; Dhindaw, Brij K., Alabama Univ., USA; Sen, Subhayu, Universities Space Research Association, USA; Curren, Peter A., NASA Marshall Space Flight Center, USA; NASA Microgravity Materials Science Conference; February 1999, pp. 599-604; In English; See also 19990040241; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

The scientific objectives of the work on Particle Engulfment and Pushing by Solidifying Interfaces (PEP) include: (1) to enhance the fundamental understanding of the physics of interaction between inert particles and the solidification interface, and (2) to investigate aspects of melt processing of particulate metal matrix composites in the unique microgravity environment that will yield some vital information for terrestrial applications. The proposal itself calls for a long-term effort on the Space Station. This paper reports on ground experiments performed to date, as well as on the results obtained from two flight opportunities, the LMS mission (1996) and the USMP-4 mission (1997).

Author

Spaceborne Experiments; Space Processing; Microgravity; Gravitational Effects; Metal Matrix Composites; Particulates; Solidification; Liquid-Solid Interfaces

19990040347 NASA Marshall Space Flight Center, Huntsville, AL USA

Magnetic Damping of Solid Solution Semiconductor Alloys

Szofran, Frank R., NASA Marshall Space Flight Center, USA; Benz, K. W., Freiburg Univ., Germany; Croell, Arne, Freiburg Univ., Germany; Dold, Peter, Freiburg Univ., Germany; Cobb, Sharon D., NASA Marshall Space Flight Center, USA; Volz, Martin P., NASA Marshall Space Flight Center, USA; Motakef, Shariar, Cape Simulations, Inc., USA; NASA Microgravity Materials Science Conference; February 1999, pp. 617-622; In English; See also 19990040241; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

The objective of this study is to: (1) experimentally test the validity of the modeling predictions applicable to the magnetic damping of convective flows in electrically conductive melts as this applies to the bulk growth of solid solution semiconducting materials; and (2) assess the effectiveness of steady magnetic fields in reducing the fluid flows occurring in these materials during processing. to achieve the objectives of this investigation, we are carrying out a comprehensive program in the Bridgman and floating-zone configurations using the solid solution alloy system Ge-Si. This alloy system has been studied extensively in environments that have not simultaneously included both low gravity and an applied magnetic field. Also, all compositions have a high electrical conductivity, and the materials parameters permit reasonable growth rates. An important supporting investigation is determining the role, if any, that thermoelectromagnetic convection (TEMC) plays during growth of these materials in a magnetic field. TEMC has significant implications for the deployment of a Magnetic Damping Furnace in space. This effect will be especially important in solid solutions where the growth interface is, in general, neither isothermal nor isoconcentrational. It could be important in single melting point materials, also, if faceting takes place producing a non-isothermal interface. In conclusion, magnetic fields up to 5 Tesla are sufficient to eliminate time-dependent convection in silicon floating zones and possibly Bridgman growth of Ge-Si alloys. In both cases, steady convection appears to be more significant for mass transport than diffusion, even at 5 Tesla in the geometries used here. These results are corroborated in both growth configurations by calculations.

Derived from text

Bridgman Method; Convective Flow; Damping; Electrical Resistivity; Float Zones; Fluid Flow; Magnetic Fields; Mass Transfer; Microgravity; Crystal Growth

19990040350 Iowa State Univ. of Science and Technology, Dept. of Materials Science and Engineering, Ames, IA USA

Interface Pattern Selection Criterion for Cellular Structures in Directional Solidification

Trivedi, R., Iowa State Univ. of Science and Technology, USA; Tewari, S. N., Cleveland State Univ., USA; Kurtze, D., North Dakota State Univ., USA; NASA Microgravity Materials Science Conference; February 1999, pp. 635-640; In English; See also 19990040241

Contract(s)/Grant(s): NCC8-898; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

The aim of this investigation is to establish key scientific concepts that govern the selection of cellular and dendritic patterns during the directional solidification of alloys. We shall first address scientific concepts that are crucial in the selection of interface patterns. Next, the results of ground-based experimental studies in the Al-4.0 wt % Cu system will be described. Both experimental studies and theoretical calculations will be presented to establish the need for microgravity experiments.

Derived from text

Directional Solidification (Crystals); Gravitational Effects; Microgravity; Foams; Thermal Diffusion; Convection; Microstructure; Bridgman Method; Mathematical Models

19990040429 National Aerospace Lab., Amsterdam, Netherlands

The Influence of Testing Parameters on Stress Corrosion Crack Growth in the High Strength Aluminium Alloy 7010-T651

Schra, L., National Aerospace Lab., Netherlands; Nov. 14, 1999; 50p; In English

Contract(s)/Grant(s): CEC-MATI-CT93-0038

Report No.(s): NLR-TP-96710-U; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

An interlaboratory testing programme to evaluate the rising displacement test for stress corrosion crack (SCC) growth investigations was carried out within the framework of the ”Measurements and Testing” programme of the European Community under BCR contract nr. MATI CT 930038. The contribution of the NLR to the project consisted of testing of precracked Double Cantilever Beam (DCB) Specimens made from the high strength aluminium alloy 7010- T651 under constant displacement and by continuous immersion in substitute ocean water. The results of these static tests were to be used as reference data for the dynamic rising displacement tests carried out by other participants in the project. Further, additional static tests were carried out by the NLR using alternate immersion in substitute ocean water. The results of these tests were compared with those of 710-T651 plate from another batch of material tested previously at the NLR. The main results of the investigation are: (1) SCC growth was much faster during Alternate immersion than during continuous immersion in substitute ocean water. (2) Application of the concept of linear fracture mechanics was possible for continuous immersion testing in substitute ocean water. A threshold value for the stress intensity factor, K(sub 1SCC) between 5 and 7 MPa(square root of m) was found in the tests. (3) No K(sub 1SCC) value could be established for alternate immersion in substitute ocean water owing to the occurrence of corrosion product wedging. The crack growth rate in the last phase of testing was more or less constant between 10(exp -9) and 2.5 x 10(exp -9) m/sec as a result of specimen self-loading by corrosion product wedging. (4) No difference in SCC growth rates was found for alternate immersion testing of 19 and 30 mm high DCB specimens, nor between 30 mm high DCB specimens obtained from surface and core locations of the plate. (5) Large differences in fracture toughness and SCC growth properties may occur between different batches of 7010-T651 plate material that meet the specified minimum mechanical properties.

Author

Corrosion; Crack Propagation; Aluminum Alloys; Stress Intensity Factors; Static Tests; Mechanical Properties; High Strength Alloys

19990040530 Department of Energy, Washington, DC USA

Direct Numerical Simulation of Solidification Microstructures Affected by Fluid Flow

Juric, D., Department of Energy, USA; Dec. 31, 1997; 11p; In English; 8th; Modeling of Casting, Welding and Advanced Solidification Processes, USA

Report No.(s): DE98-001611; LA-UR-97-3918; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The effects of fluid flow on the solidification morphology of pure materials and solute microsegregation patterns of binary alloys are studied using a computational methodology based on a front tracking/finite difference method. A general single field formulation is presented for the full coupling of phase change, fluid flow, heat and solute transport. This formulation accounts for interfacial rejection/absorption of latent heat and solute, interfacial anisotropies, discontinuities in material properties between the liquid and solid phases, shrinkage/expansion upon solidification and motion and deformation of the solid. Numerical results are presented for the two dimensional dendritic solidification of pure succinonitrile and the solidification of globulitic grains of a plutonium-gallium alloy. For both problems, comparisons are made between solidification without fluid flow and solidification within a shear flow.

NTIS

Solidification; Binary Alloys; Fluid Flow; Shear Flow; Direct Numerical Simulation; Computational Fluid Dynamics; Finite Difference Theory

19990040532 Department of Energy, Office of Financial Management and Controller, Washington, DC USA

Materials and Properties of Components Formed Using the 3DWire Process

Griffith, M. L., Department of Energy, USA; Harwell, L. D., Department of Energy, USA; Greene, D. L., Department of Energy, USA; Romero, J. A., Department of Energy, USA; Buchheit, T. E., Department of Energy, USA; Dec. 31, 1997; 8p; In English; 3rd; Pacific Rim: Advanced Materials and Processing, USA

Report No.(s): DE98-001698; SAND-97-3116C; CONF-980716; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Direct metal deposition technologies produce complex, near net shape components from CAD solid models. Most of these techniques fabricate a component by melting powder in a laser weld pool, rastering this weld bead to form a layer, and additively constructing subsequent layers. Powder feed material in these processes results in near net shape, high strength components, with the ability to blend materials for novel properties. This talk will describe a new direct metal deposition process, known as 3DWire,

whereby a small diameter wire is used instead of powder as the feed material to fabricate components. This allows for faster deposition rates, smoother surface finishes, and easy material handling. Currently, parts are being fabricated from 308L stainless steel and Aermet(reg-sign) 100. Microscopy studies show the 3DWire parts to be fully dense with fine microstructural features. Initial mechanical tests show stainless steel parts to have good strength values (sigma(sub y) = 58 ksi, sigma(sub ult) = 95 ksi, 87 HRB) with retained ductility (65%).
NTIS
Stainless Steels; Manufacturing

19990040654 Oak Ridge National Lab., TN USA
Neural network model for predicting ferrite number in stainless steel welds
Vitek, J. M.; Iskander, Y. S.; Oblow, E. M.; Babu, S. S.; David, S. A.; Dec. 31, 1998; 6p; In English; 5th; Trends in welding research
Report No.(s): DE99-000391; ORNL/CP-99107; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Predicting the ferrite content in stainless steel welds is desirable in order to assess an alloy's susceptibility to hot cracking and to estimate the as-welding properties. Several methods have been used over the years to estimate the ferrite content as a function of the alloy composition. A new technique is described which uses a neural network analysis to determine the ferrite number. The network was trained on the same data set that was used to generate the WRC-1992 constitution diagram. The accuracy of the neural network predictions is compared to that for the WRC-1992 diagram as well as another recently proposed method. It was found that the neural network model was approximately 20% more accurate than either of the other two methods. In addition, it is suggested that further improvements to the neural network model, including the consideration of process variables, can be made which lead to even better accuracy.
NTIS
Network Analysis; Mathematical Models; Predictions; Welding; Stainless Steels; Ferrites

19990040670 Oak Ridge National Lab., Metals and Ceramics Div., TN USA
Role of ALCHEMI in understanding the properties of ordered intermetallic alloys
Anderson, I. M., Oak Ridge National Lab., USA; Dec. 31, 1998; 16p; In English; Sponsored by Department of Energy, USA
Report No.(s): DE99-000361; ORNL/CP-98595; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

After one and one-half decades of development, ALCHEMI is approaching the status of an established analytical technique. Many of the problems that have plagued ALCHEMI, especially for the analysis of ordered intermetallic alloys, are now well understood, and accurate site-distributions can be extracted from a variety of intermetallic alloys. This paper begins with an overview of the factors that can lead to large systematic errors or gross misinterpretations of ALCHEMI data, with illustrations from a variety of ordered intermetallic alloys. The paper concludes with a discussion of ALCHEMI in the broader context of understanding the properties of ordered intermetallic alloys. The results of systematic studies are used to illustrate the role of ALCHEMI in determining the competing effects of thermodynamic and kinetic factors during alloy processing and the correlation of alloy properties with the atomic site distributions on which the properties ultimately depend.
NTIS
Intermetallics; Systematic Errors

19990040690 Los Alamos National Lab., NM USA
Ultra-narrow gap laser welding of BeAl alloys ***Final Report***
Milewski, J. O.; Sklar, E.; Dec. 31, 1998; 7p; In English
Report No.(s): DE99-000876; LA-CRADA-98-2; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The original scope of the project was to develop a method to enhance the laser welding of BeAl alloys by the use of weld joint designs based on the principals of non-imaging optics. The projected three year program focused on the development of geometric optical models which predict the trapping of laser energy within the weld joint and experimental validation of these models. The first year was fully funded, meeting all expectations and deliverables for the demonstration of the method for aluminum only. The second year funding levels did not allow any work to be done at Los Alamos. OptiCAD continued with model development with a change in scope to model the laser welding requirements of ongoing weapons related programs which could provide data for model validation. The project ended at the end of FY97 without funding a third year and never reaching the goal of welding beryllium, as a result. Despite the poor funding situation, original quality process research was accomplished and reported as described in the three technical reports of Appendix A. Solid technical contribution, directly applicable to weapons programs is

evidenced by the inclusion of an optically designed laser weld joint being specified on a LANL drawing of an aluminum subassembly.
NTIS
Laser Welding; Beryllium Alloys; Aluminum Alloys

19990040776 Los Alamos National Lab., NM USA
Magnetic order of Co(0.1)Pt(0.9) in proximity in CoPt3
Shapiro, A. L.; Hellman, F.; Fitzsimmons, M. R.; Dec. 31, 1998; 7p; In English; Spring Meeting of the Materials Research Society
Report No.(s): DE99-001134; LA-UR-98-2358; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

A polarized neutron reflectometry study of the magnetization density depth profile of a Co(sub 0.1)Pt(sub 0.9)-CoPt(sub 3) bilayer film found evidence for an induced moment in the Co(sub 0.1)Pt(sup 0.9) overlayer in close proximity to the CoPt(sub 3) underlayer. If the moment of Co in these films is that of the bulk, then the (mu)(sub Pt) = 0.09(1)(mu)(sub B) in the overlayer, and (mu)(sub Pt) = 0.04(1)(mu)(sub B) in the underlayer. In addition, ferromagnetic order of the Co(sub 0.1)Pt(sub 0.9) overlayer was observed 8K above (Tc) for the material in the bulk.
NTIS
Magnetic Moments; Cobalt Alloys; Platinum Alloys; Optical Measurement

19990040782 Department of Energy, Office of Energy Research, Washington, DC USA
Surface phases, surface defects and initial stages of oxidation ***Final Report***
Blakely, J.; May 31, 1998; 8p; In English
Report No.(s): DE99-001020; DOE/ER/45328-T1; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

A major goal of this project has been to develop an understanding of the structure and thermodynamics of 2-dimensional, 2-component adsorbed systems. Such adsorbed systems occur frequently in surface reactions and the author believes them to be particularly important in metal oxidation. The distribution of surface phases affects the mode of growth and the ultimate adhesion characteristics of the metal-oxide interface. The author has focused on the coadsorption of oxygen and sulphur on transition metal alloys, the phases that are observed at low surface coverages, the effect that S has on the subsequent oxide formation and the conditions under which oxide layers are broken up by elemental S attack. This report gives a brief summary of progress during the grant period in the following areas: (1) Experimental study of 2-dimensional, 2- component adsorbed phase equilibria; (2) Computations of phase diagrams for comparison with experiment; (3) Environmental SEM work on S attack on surfaces with patterned atomic step arrays; and (4) Development of capabilities for examining low conductivity surfaces with STM.
NTIS
Surface Defects; Phase Diagrams; Oxidation; Metal Oxides

19990040789 Oak Ridge National Lab., TN USA
Neural network modeling of pulsed-laser weld pool shapes in aluminum alloy welds
Vitek, J. M., Oak Ridge National Lab., USA; Iskander, Y. S., Oak Ridge National Lab., USA; Oblow, E. M., Oak Ridge National Lab., USA; Babu, S. S., Oak Ridge National Lab., USA; David, S. A., Oak Ridge National Lab., USA; Dec. 31, 1998; 7p; In English; 5th; trends in welding research; Sponsored by Department of Energy, USA
Report No.(s): DE99-000362; ORNL/CP-98605; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

A model was developed to predict the weld pool shape in pulsed Nd:YAG laser welds of aluminum alloy 5754. The model utilized neural network analysis to relate the weld process conditions to four pool shape parameters: penetration, width, width at half-penetration, and cross-sectional area. The model development involved the identification of the input (process) variables, the desired output (shape) variables, and the optimal neural network architecture. The latter was influenced by the number of defined inputs and outputs as well as the amount of data that was available for training the network. After appropriate training, the best network was identified and was used to predict the weld shape. A routine to convert the shape parameters into predicted weld profiles was also developed. This routine was based on the actual experimental weld profiles and did not impose an artificial analytical function to describe the weld profile. The neural network model was tested on experimental welds. The model predictions were excellent. It was found that the predicted shapes were within the experimental variations that were found along the length of the welds (due to the pulsed nature of the weld power) and the reproducibility of welds made under nominally identical conditions.
NTIS
Neural Nets; Network Analysis; Mathematical Models; Pulsed Lasers; Aluminum Alloys; Laser Welding

19990040809 Department of Energy, Washington, DC USA

Interactions of Zircaloy cladding with gallium: 1998 midyear status

Wilson, D. F., Department of Energy, USA; DiStefano, J. R., Department of Energy, USA; Strizak, J. P., Department of Energy, USA; King, J. F., Department of Energy, USA; Manneschmidt, E. T., Department of Energy, USA; Jun. 30, 1998; 43p; In English
Report No.(s): DE98-058149; ORNL/TM-13625; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

A program has been implemented to evaluate the effect of gallium in mixed- oxide (MOX) fuel derived from weapons-grade (WG) plutonium on Zircaloy cladding performance. The objective is to demonstrate that low levels of gallium will not compromise the performance of the MOX fuel system in a light-water reactor. The graded, four-phase experimental program was designed to evaluate the performance of prototypic Zircaloy cladding materials against (1) liquid gallium (Phase 1), (2) various concentrations of Ga(sub 2)O(sub 3) (Phase 2), (3) centrally heated surrogate fuel pellets with expected levels of gallium (Phase 3), and (4) centrally heated prototypic MOX fuel pellets (Phase 4). This status report describes the results of a series of tests for Phases 1 and 2. Three types of tests are being performed: (1) corrosion, (2) liquid metal embrittlement, and (3) corrosion-mechanical. These tests will determine corrosion mechanisms, thresholds for temperature and concentration of gallium that may delineate behavioral regimes, and changes in the mechanical properties of Zircaloy. Initial results have generally been favorable for the use of WG- MOX fuel. The MOX fuel cladding, Zircaloy, does react with gallium to form intermetallic compounds at (ge)300 C; however, this reaction is limited by the mass of gallium and is therefore not expected to be significant with a low level (parts per million) of gallium in the MOX fuel. Although continued migration of gallium into the initially formed intermetallic compound can result in large stresses that may lead to distortion, this was shown to be extremely unlikely because of the low mass of gallium or gallium oxide present and expected clad temperatures below 400 C. Furthermore, no evidence for grain boundary penetration by gallium has been observed.

NTIS

Evaluation; Distortion; Fuel Systems; Gallium Compounds; Migration; Oxides; Pellets; Zircaloys (Trademark)

19990040872 Oak Ridge National Lab., TN USA

Inclusion formation in low-alloy steel welds

Babu, S. S.; David, S. A.; DebRoy, T.; Dec. 31, 1998; 6p; In English; 5th; Trends in welding research
Report No.(s): DE99-000219; ORNL/CP-99123; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

This paper summarizes four models for describing inclusion formation in steel welds. These methods include simple fixed oxidation sequence model, thermodynamic model, thermodynamic-kinetic model, and thermodynamic-kinetic-fluid flow model. Complexities of these models increase with a need to describe details of the inclusion formation. The applicability of the models was illustrated with two examples. In one of the examples, thermodynamic calculations of phase stability between liquid steel, AlN and Al2O3 explained the inclusion formation in self-shielded flux cored arc weld. In the second example, thermodynamic-kinetic calculations illustrated the competing effects of weld metal composition and cooling rate effects on the inclusion formation in electron beam and laser beam welds. Limitations of the current inclusion models and recommendations for future work on the inclusion formation were highlighted.

NTIS

Steels; Welding; Inclusions; High Strength Steels

19990040873 Oak Ridge National Lab., TN USA

Atom probe field-ion microscopy investigation of nickel base superalloy welds

Babu, S. S.; David, S. A.; Vitek, J. M.; Miller, M. K.; Dec. 31, 1998; 6p; In English; 5th; Trends in welding research
Report No.(s): DE99-000218; ORNL/CP-99118; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Microstructure development and elemental partitioning between (gamma) and (gamma)(prime) were measured in PWA-1480 electron beam welds and CMSX-4 pulsed- laser welds. In PWA-1480 EB welds, eutectic (gamma)(prime) phases were observed along the dendritic boundaries. The elemental partitioning between (gamma) and (gamma)(prime) was found to be similar to that in PWA-1480 base metal. In CMSX- 4 pulsed laser welds, negligible eutectic (gamma)(prime) was observed. In addition, fine and irregularly shaped (gamma)(prime) precipitates were observed. The elemental partitioning between (gamma) and (gamma)(prime) was found to be different from that measured in the base metal. Large concentration gradients were observed in the (gamma) phase. The (gamma)(prime) precipitation kinetics in CM247DS alloy was measured using dilatometry and showed differences with different cooling rates. The microstructural investigations showed that at large undercoolings the number density of (gamma)(prime) precipitates increased and led to a finer size. This supports the microstructure development observations in PWA-1480 and CMSX-4 welds. Thermodynamic and kinetic calculations for the Ni-Al-Cr alloy system showed that as the cooling

rate increases, the (gamma)(prime) growth leads to large concentration gradients in the (gamma) phase. The calculations agree with the atom probe results from PWA-1480 and CMSX-4 welds.
NTIS
Welded Joints; Nickel Alloys; Atomic Force Microscopy

19990040955 Department of Energy, Washington, DC USA
Rapid tooling by electron-beam vapor deposition
Meier, T.; Feb. 25, 1998; 11p; In English
Report No.(s): DE98-058756; UCRL-ID-129943; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Electron-beam physical vapor deposition (EBPVD) of tooling metal, onto a shaped substrate to produce a replica of the substrate surface, offers the potential for significant cost savings over present methods of injection mold manufacturing. These savings are realized by the high deposition rate and the corresponding short manufacturing times provided by the EBPVD process. However, on route to realizing these gains, there are process technical issues which need to be resolved. Mold surfaces typically contain relatively high aspect ratio details that must be replicated to dimensional tolerances within +/- 2 mils. The deposited mold material must also provide high surface hardness and high fracture toughness. Good quality grain structure can be obtained in deposited Al 10-wt% Cu mold material when the substrate and corresponding deposit are at high process temperature. However, the resulting mold is subject to distortion during cooldown due to differential temperatures and shrinkage rates. Thermally controlled cooldown and the use of crushable substrate materials reduce these distortions, but not to the required levels of tolerance. Deposition of the Al-Cu at lower temperature produces columnar, poorly joined grains which result in a brittle and weakened mold material. When Al 10-wt% Cu metal vapor is deposited across high aspect ratio step features on the substrate surface, a grain growth defect can form in the step-shadowed regions of the deposited material, alongside the step feature. The step coverage defect consists of entrained voids which persist at intermediate deposition temperatures and produce a weakened mold. This final 1997 LDRD report investigates causes of this step coverage defect and offers methods for their control and elimination.
NTIS
Tooling; Electron Beams; Vapor Deposition

19990041039 Oak Ridge National Lab., TN USA
Effects of beryllium additions on the oxidation of nickel aluminide and titanium aluminide based intermetallics
Hanrahan, R. J.; Chen, K. C.; Brady, M. P.; Dec. 31, 1998; 8p; In English; 193rd; Meeting of the Electrochemical Society, Inc.
Report No.(s): DE99-000382; ORNL/CP-99047; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The effects of Be additions on the oxidation behavior of (beta)-NiAl in moist air at 1,000 C as well as on the borderline alumina-forming (gamma) + Laves Ti-Al-Cr based alloys at 800 C and 1,000 C in dry and moist air were investigated. The addition of Be to (beta)-NiAl suppressed the formation of transient alumina and resulted in the formation of a protective BeAl2O4 spinel phase. In dry air, the addition of Be to the Ti-Al-Cr alloys also resulted in the formation of a protective BeAl2O4 spinel phase. In moist air, only Ti-Al-Cr-Be alloys with a high Cr content (10 to 15 a/o) formed the protective BeAl2O4 scale.
NTIS
Protective Coatings; Beryllium; Addition; Nickel Aluminides; Titanium Aluminides; Metallurgy

19990041040 Oak Ridge National Lab., Metals and Ceramics Div., TN USA
Ultrahigh temperature intermetallic alloys
Brady, M. P.; Zhu, J. H.; Liu, C. T.; Tortorelli, P. F.; Wright, J. L.; Dec. 31, 1998; 8p; In English; 12th; Annual conference on fossil energy materials
Report No.(s): DE99-000381; ORNL/CP-99045; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

A new family of Cr-Cr2Ta intermetallic alloys based on Cr-(6 - 10)Ta (at.%) is under development for structural use in oxidizing environments in the 1,000-1,300 C (1,832 - 2,372 F) temperature range. Development objectives relate to high temperature strength and oxidation resistance and room temperature fracture toughness. The 1,200 C (2,192 F) strength goals have been met: yield and fracture strengths of 275 MPa (40 ksi) and 345 MPa (50 ksi), respectively, were achieved. Progress in attaining reasonable fracture toughness of Cr-Cr2Ta alloys has been made; current alloys exhibit room-temperature values of about 10 - 12 MPa(radical)m (1.1 MPa(radical)m = 1 ksi(radical)in.). Oxidation rates of these alloys at 950 C (1,742 F) in air are in the range of those reported for chromia-forming alloys. At 1,100 C (2,012 F) in air, chromia volatility was significant but, nevertheless, no scale spallation and positive weight gains of 1 - 5 mg/sq cm have been observed during 120-h, 6-cycle oxidation screening tests.

These mechanical and oxidative properties represent substantial improvement over Cr-Cr2Nb and Cr-Cr2Zr alloys previously developed.
NTIS
Chromium Alloys; Tantalum Alloys; High Temperature; Intermetallics; Oxidation Resistance; Mechanical Properties

19990041067 Department of Energy, Office of Energy Research, Washington, DC USA
Depth of penetration in gas metal arc welding
Murray, P. E., Department of Energy, USA; Scotti, A., Department of Energy, USA; Dec. 31, 1998; 6p; In English; 5th; Trends in Welding Research, USA
Report No.(s): DE98-057366; INEEL/CON-98-00694; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The authors present a model of the depth of penetration in gas metal arc welding. This model is based on the assumption that the heat and mass transfer to the weld pool and the depth of penetration may be correlated by a dimensionless relation. This correlation leads to an analytical expression for depth of penetration, which involves empirical constants that are related to the efficiency of heat and mass transfer to the pool. They examine the accuracy of the model by comparing the theoretical depth of penetration and the measured depth of the weld pool for a range of processing variables encompassing short arc and free flight mass transfer. Measurements are obtained from bead on plate welds of stainless steel using a stainless steel electrode and a shielding gas that is rich in argon. The results confirm that the depth of penetration is affected by variations in the rate of mass transfer.
NTIS
Mathematical Models; Heat Transfer; Mass Transfer; Arc Welding; Metal Plates; Welded Joints; Gas Welding

19990041072 Oak Ridge National Lab., Metals and Ceramics Div., TN USA
Effect of microstructure and temperature on the oxidation behavior of two-phase Cr-Cr2X (X = Nb, Ta) alloys
Brady, M. P.; Tortorelli, P. F.; Dec. 31, 1998; 12p; In English; 193rd; Meeting of the Electrochemical Society, Inc.
Report No.(s): DE99-000380; ORNL/CP-99043; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The oxidation behavior of Cr(X) solid solution (Cr(sub ss)) and Cr2X Laves phases (X = Nb, Ta) was studied individually and in combination at 950 - 1,100 C in air. The Cr(sub ss) phase was significantly more oxidation resistant than the Cr2X Laves phase. At 950 C, two-phase alloys of Cr-Cr2 and Cr-Cr2Ta exhibited in-situ internal oxidation, in which remnants of the Cr2X Laves phase were incorporated into a growing chromia scale. At 1,100 C, the Cr-Cr2Nb alloys continued to exhibit in-situ internal oxidation, which resulted in extensive O/N penetration into the alloy ahead of the alloy-scale interface and catastrophic failure during cyclic oxidation. IN contrast, the Cr-Cr2Ta alloys exhibited a transition to selective Cr oxidation and the formation of a continuous chromia scale. The oxidation mechanism is interpreted in terms of multiphase oxidation theory.
NTIS
Microstructure; Chromium Alloys; Niobium Alloys; Temperature Effects

19990041073 Oak Ridge National Lab., TN USA
Effects of interactive particles on steel weldability
Eijk, C.; Grong, O.; Babu, S. S.; David, S. A.; Dec. 31, 1998; 6p; In English; 5th; International conference on trends in welding research
Report No.(s): DE99-000379; ORNL/CP-99005; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The concept of intragranular ferrite nucleation by specific inclusions is well known from steel weld metals. In this paper it is shown that the idea can be transferred to steel metallurgy. Control of the inclusion composition and thus the nucleation potency with respect to ferrite can readily be achieved by the choice of an appropriate deoxidation procedure. Thermodynamic (Thermo-Calc) calculations in addition to X-ray mappings and microprobe analysis are employed to understand and predict the inclusion formation in the steels. Three different steels, two of them Ti-deoxidized, and one Al-Ca-deoxidized, have been subjected to weld thermal simulation at different peak temperatures and cooling programs followed by Charpy-V notch testing at (minus)40 C to reveal differences in the HAZ toughness. The results from these tests show that the titanium deoxidized steels exhibit excellent toughness in the grain coarsened HAZ after high heat input weld simulation because of a refinement of the microstructure. This observation is in contrast to the more traditional behavior of the conventional Al-Ca deoxidized steels, which show no evidence of intragranular ferrite formation.
NTIS
Welding; Microstructure; Steels; Weldability; Technology Transfer; Charpy Impact Test; Heat Affected Zone; Metals

19990041074 Oak Ridge National Lab., TN USA

Influence of microstructure on the properties of resistance spot welds

Santella, M. L.; Babu, S. S.; Riemer, B. W.; Feng, Z.; Dec. 31, 1998; 5p; In English; 5th; International conference on trends in welding research

Report No.(s): DE99-000378; ORNL/CP-98996; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

An integrated model approach was proposed for relating resistance welding parameters to weldment properties. A key element of the approach is microstructure modeling. It was demonstrated that existing process models and microstructure models can be used to determine the spatial distribution of microstructures and properties in resistance spot welds of a plain carbon steel. It was also shown by finite element analysis that the existence of microstructure gradients in the welds is expected to reduce their ability to support shear loads by about 50%.

NTIS

Microstructure; Carbon Steels; Spot Welds; Welded Joints; Welding; Models

19990041086 NASA Lewis Research Center, Cleveland, OH USA

Development of Directionally Solidified NiAl Alloys for Aircraft Engine Applications

Raj, S. V., NASA Lewis Research Center, USA; Locci, I. E., NASA Lewis Research Center, USA; Whittenberger, J. D., NASA Lewis Research Center, USA; Creep Behavior of Advanced Materials for the 21st Century; 1999, pp. 295-310; In English; No Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

Binary NiAl has attractive thermophysical properties and excellent oxidation resistance which make it a potential candidate for use as turbine blades and vanes in aircraft gas turbine engines. However, it possesses poor high temperature creep and low temperature fracture resistance properties which have limited its use in these applications. One method for potentially improving these properties is through the use of directional solidification technology. This paper reviews current efforts underway to improve the elevated temperature creep properties of NiAl eutectic alloys.

Author

Product Development; Eutectic Alloys; Nickel Aluminides; Creep Properties; Oxidation Resistance; Thermophysical Properties

19990041096 Oak Ridge National Lab., Metals and Ceramics Div., TN USA

Fabric cutting application of FeAl-based alloys

Sikka, V. K.; Blue, C. A.; Sklad, S. P.; Deevi, S. C.; Shih, H. R.; Dec. 31, 1998; 15p; In English; Annual meeting of the Minerals, Metals and Materials Society (TMS)

Report No.(s): DE99-000389; ORNL/CP-99091; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Four intermetallic-based alloys were evaluated for cutting blade applications. These alloys included Fe3Al-based (FAS-II and FA-129), FeAl- based (PM-60), and Ni3Al-based (IC-50). These alloys were of interest because of their much higher work-hardening rates than the conventionally used carbon and stainless steels. The FeAl-based PM-60 alloy was of further interest because of its hardening possibility through retention of vacancies. The vacancy retention treatment is much simpler than the heat treatments used for hardening of steel blades. Blades of four intermetallic alloys and commercially used M2 tool steel blades were evaluated under identical conditions to cut two-ply heavy paper. Comparative results under identical conditions revealed that the FeAl-based alloy PM-60 outperformed the other intermetallic alloys and was equal to or somewhat better than the commercially used M2 tool steel.

NTIS

Aluminum Alloys; Cutting; Intermetallics; Performance Tests; Cutters

27
NONMETALLIC MATERIALS

Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials. For composite materials see 24 Composite Materials.

19990038348 Army Soldier and Biological Chemical Command, Soldier systems center, Natick, MA USA

Interactive Textiles Front End Analysis, Phase 1 ***Final Report, Aug. 1997 - Mar. 1998***

Leitch, Paul; Tassinari, Thomas; Winterhalter, Carole; Fairneny, James; Herbert, Jean; Nov. 1998; 49p; In English

Report No.(s): AD-A361143; NATICK/TR-99/004; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A Front End Analysis (FEA) was initiated to identify Interactive Textiles that could be used by the Soldier Systems Center - Natick (SSC-N) for the improvement of Soldier System warfighter materiel. Phase I focused on the Sensate Liner, which is a

garment constructed to detect the location of a wound in the torso by means of a conductive fiber grid sewn into a ”t-shirt”. The garment would, using attached acoustic sensors, also indicate the type and path of the projectile that penetrated the torso. Future Operational Capabilities were reviewed. A survey was developed to collect judgements of combat effectiveness, mission relevance, technical feasibility, and risk criteria. These data were used to arrive at a Figure of Merit (FoM) which was then related to management alternatives. The value of the FoM fell in the ”Monitor Program” alternative range. Major conclusions from this analysis were: (1) Future Operational Capabilities support a number of alternatives relating to casualty care and tele-medicine concepts; and (2) The FoM falls into a range of values corresponding to Management actions of monitoring or consulting. Recommendations were: (1) that SSC-N monitor progress of the Sensate Liner project and (2) conduct Phase II of the FEA.
DTIC
Textiles; Technology Assessment

19990038373 Department of Energy, Office of Energy Research, Washington, DC USA
X-ray resonant exchange scattering of rare-earth nickel borocarbides
Detlefs, C., Department of Energy, USA; Oct. 08, 1997; 131p; In English
Report No.(s): DE98-004646; IS-T-1821; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The purpose of this thesis is to investigate the systematics of the microscopic magnetic order within a series of isostructural compounds and, at the same, to develop the relatively young experimental method of x-ray resonant exchange scattering (XRES). In this thesis, the author presents XRES studies of several rare-earth nickel borocarbides, RNi2B2C. He shows that XRES, similar to the neutron techniques, allows the determination of the orientation of the magnetic moment by measuring the Q-dependence of the scattered intensity of magnetic Bragg reflections. As samples in this study, he chose the recently discovered family of rare-earth nickel borocarbides, RNi2B2C, which display a wide variety of magnetic structures. Furthermore, in several of these materials, long range magnetic order coexists with superconductivity over some temperature range.
NTIS
X Ray Scattering; Rare Earth Elements; Nickel; Carbides

19990038376 Department of Energy, Assistant Secretary for Energy Efficiency and Renewable Energy, Washington, DC USA
Effect of sample test volume and geometry on the tensile mechanical behavior of SiC/SiC continuous fiber ceramic composites *Final Report*
Sankar, J., Department of Energy, USA; Kelkar, A. D., Department of Energy, USA; Neogi, J., Department of Energy, USA; Dec. 31, 1998; 50p; In English
Report No.(s): DE98-007373; DOE/OR/22119-T1; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The development of a silicon carbide-type fiber from an organometallic precursor has led to a major resurgence of interest in fiber-reinforced ceramic matrix composites. by combining this high strength fiber with a variety of ceramic matrices it has been possible to achieve tough composites offering significant potential advantages over monolithic ceramics and carbon-carbon for high temperature applications. A continuous-fiber ceramic matrix composite (CFCC) typical of materials proposed for such industrial applications as power generation, heat recovery and chemical production as well as biomedical and environmental applications was tested in uniaxial tension using a universal test machine. Test parameters investigated included: test mode (load versus displacement), test rate (0.003 mm/s, 0.03 mm/s, 50 N/s and 500 N/s), specimen geometry (straight-sided versus reduced-gauge section) and type of specimen volume (long/thin versus short/fat). Typical properties include an average elastic modulus 130 +/-10 Gpa, an average proportional limit stress of 45 +/-20 Mpa, an average ultimate tensile strength of 180 +/-20 MPa and an average modulus of toughness of 8.4 +/-2 x 10(exp 5) J/m(exp 3).
NTIS
Tensile Strength; Silicon Carbides; Fiber Composites; Ceramic Matrix Composites; Matrix Materials; Specimen Geometry

19990039096 CSA Engineering, Inc., Palo Alto, CA USA
Properties of Viscoelastic Materials Under Centrifugal Loads
Feb. 1998; 34p; In English
Report No.(s): AD-A361420; ASIAC-98-02-01; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Hardware representative of viscoelastic damping material in a cavity in a spinning jet engine blade was investigated. Specimens representing jet engine fan blades were analyzed, designed, fabricated and spun to establish that elastomer filled cavities may be satisfactorily designed for in service high-g and thermal loading and satisfactorily analyzed using conventional finite ele-

ment analysis. A spin rate of 7500 RPM at a radius of 16 inches was achieved which resulted in a g-level of 25,500. Some excitation and response vibration data during spin were acquired. Static strain readings were taken for the cavIty walls.
DTIC
Viscoelasticity; Damping; Elastomers

19990039106 Sheffield Univ., UK
International Workshop on Glasses and Ceramics Hybrids & Nanocomposites from Gels; Sol-Gel 1997
Hand, Russell J.; James, Peter F.; Seddon, Angela B.; Journal of Sol-Gel Science and Technology; Jan. 1998; Volume 1; 1005p; In English; 9th, 31 Aug. - 5 sep. 1997, Sheffield, UK
Contract(s)/Grant(s): N62909-97-MP-0508
Report No.(s): AD-A361407; No Copyright; Avail: Issuing Activity (Defense Technical Information Center (DTIC)), Microfiche
Advances in high performance materials for structural and functional applications depend on the development of materials processing which allows for the regulation of phenomena and structures at atomic, molecular, nanoscale and micrometer scale levels. Sol-gel processing provides such materials in an efficient manner, and tremendous opportunities are now open for developing and producing novel high technology materials.
DTIC
Sol-Gel Processes; Glass; Ceramics; Composite Materials

19990039196 Department of Energy, Washington, DC USA
Lifetime predictions for alumina ceramics used in nuclear weapons stockpile components
Glass, S. J., Department of Energy, USA; Monroe, S. L., Department of Energy, USA; Newton, C., Department of Energy, USA; Sep. 30, 1997; 5p; In English; 21st; Aging, Compatibility, and Stockpile Stewardship, USA
Report No.(s): DE98-000195; SAND-97-2127C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
Ceramic materials are used extensively in non-nuclear components in the weapons stockpile including neutron tubes, firing sets, radar, strong link and weak link assemblies, batteries, and current/voltage stacks. Ceramics also perform critical functions in electronics, passively as insulators and actively as resistors and capacitors. Glass and ceramic seals also provide hermetic electrical feedthroughs in connectors for many weapons components. The primary goal of the ceramic material lifetime prediction program is to provide the enhanced surveillance program with the capability to specify the reliability and lifetimes of glass and ceramic-containing components under conditions typical of the stockpile environment. The authors have studied the reliability and subcritical crack growth (SCG) behavior of 94% alumina (Al2O3), which is likely the most common ceramic in the stockpile. Measurements have been made on aluminas manufactured by four war reserve qualified vendors (Coors, Wesgo, AlSiMag, and Diamonite). These materials are expected to be representative of typical product obtained from vendors who have supplied alumina for weapons components during the past several decades.
NTIS
Service Life; Nuclear Weapons; Ceramics; Reliability; Predictions; Crack Propagation

19990039203 Department of Energy, Washington, DC USA
Complex impurity dynamics in silicon
Pantelides, S. T., Department of Energy, USA; Maiti, A., Department of Energy, USA; Ramamoorthy, M., Department of Energy, USA; Chisholm, M. F., Department of Energy, USA; Pennycook, S. J., Department of Energy, USA; Mar. 31, 1998; 12p; In English; 19th; Semiconductor, USA
Report No.(s): DE98-004662; ORNL/CP-97034; CONF-961036; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
The authors review results of recent first-principles calculations that have led to comprehensive descriptions of a wide range of dynamical properties of impurities in Si. In particular, they review the dynamics of clustering and declustering of As impurities in heavily-doped crystalline Si, the segregation of As impurities in the form of ordered chains in grain boundaries, and the very complex though seemingly simple migration of oxygen impurities in Si.
NTIS
Silicon; Impurities; Dynamic Characteristics

19990039212 Department of Energy, Washington, DC USA
Polymerization of trialkoxysilanes. Effect of the organic substituter on the formation of gels
Loy, D. A., Department of Energy, USA; Baugher, B. M., Department of Energy, USA; Schneider, D. A., Department of Energy, USA; Dec. 31, 1998; 4p; In English; Sponsored by American Chemical Society, USA

Report No.(s): DE98-005899; SAND-98-1342C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Hydrolysis and condensation of trialkoxysilanes, R-Si(OR(prime))(sub 3), generally leads to the formation of silsesquioxane oligomers and polymers. These polymers are composed of a monomer repeat unit, (R-SiO(1.5))(sub n), with a single silicon atom attached to other repeat units in the polymer through one to three siloxane bonds. The remaining substituter is an organic group attached to the silicon through a silicon-carbon single bond. Silsesquioxanes have been the subject of intensive study in the past and are becoming important again as a vehicle for introducing organic functionalities into hybrid organic-inorganic materials through sol-gel processing. Despite all of this interest, there has not been a systematic study of the ability of trialkoxysilanes to form gels through the sol-gel process. In fact, it has been noted that silsesquioxanes are generally isolated as soluble resins rather than the highly crosslinked network polymers (gels) one would expect from a tri-functional monomer. In this study, the authors have examined the sol-gel chemistry of a variety of trialkoxysilanes with different organic substituents (R = H, Me, Et, n-Pr, i-Pr, n-Bu, i-Bu, t-Bu, n-octadecyl, n-dodecyl, cyclohexyl, vinyl, phenyl, benzyl, phenethyl), with methoxide or ethoxide substituents on silicon, at varying monomer concentrations ranging up to neat monomer, and with different catalysts (HCl, NaOH, formic acid, fluoride). Gels were prepared from tetramethoxysilane and tetraethoxysilane at identical concentrations for purposes of comparison.

NTIS

Polymerization; Hydrolysis; Cyclohexane; Sol-Gel Processes; Condensing

19990039560 Sheffield Univ., UK

11th International Symposium on Non-Oxide and New Optical Glasses

Sep. 1998; 603p; In English; 11th, 6-10 Sep. 1998, Sheffield, UK

Report No.(s): AD-A361364; No Copyright; Avail: CASI; A99, Hardcopy; A06, Microfiche

The abstracts of the eleventh International Symposium on non-oxide glasses and new optical glasses at Sheffield, UK is presented.

DTIC

Glass; Conferences; Optical Materials; Oxides

19990039562 Defence Research Establishment Atlantic, Dartmouth, Nova Scotia Canada

Characterization of Poly(ether)urethane Thermoplastic Elastomers

Hiltz, John A.; Aug. 1998; 37p; In English

Report No.(s): AD-A361313; DREA-TM-98/222; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The VDS tow cable has had a history of problems with the elastomer link that ties the fairing components together. Several changes have been made to the cable system and link to compensate but problems still exist. In this study, the results of the chemical, dynamic mechanical and thermal characterization of five polyurethane thermoplastic elastomers are reported. These were proposed as candidate materials to replace the poly(ether)urethane elastomer in use. The results are discussed in terms of the composition, percentage hard and soft segments, degree of phase mixing, and effect of hard segment length on the properties of he five poly(ether)urethane elastomers.

DTIC

Elastomers; Research; Thermoplasticity; Mechanical Properties; Towing; Cables (Ropes)

19990039584 Department of Energy, Washington, DC USA

Modeling decomposition of rigid polyurethane foam

Hobbs, M. L., Department of Energy, USA; Jan. 31, 1998; 20p; In English; 27th; Combustion, USA

Report No.(s): DE98-005723; SAND-98-0065C; CONF-980804; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Rigid polyurethane foams are used as encapsulants to isolate and support thermally sensitive components within weapon systems. When exposed to abnormal thermal environments, such as fire, the polyurethane foam decomposes to form products having a wide distribution of molecular weights and can dominate the overall thermal response of the system. Decomposing foams have either been ignored by assuming the foam is not present, or have been empirically modeled by changing physical properties, such as thermal conductivity or emissivity, based on a prescribed decomposition temperature. The hypothesis addressed in the current work is that improved predictions of polyurethane foam degradation can be realized by using a more fundamental decomposition model based on chemical structure and vapor-liquid equilibrium, rather than merely fitting the data by changing physical properties at a prescribed decomposition temperature. The polyurethane decomposition model is founded on bond breaking of the primary polymer and formation of a secondary polymer which subsequently decomposes at high temperature. The bond breaking scheme is resolved using percolation theory to describe evolving polymer fragments. The polymer fragments vaporize according

to individual vapor pressures. Kinetic parameters for the model were obtained from Thermal Gravimetric Analysis (TGA) from a single nonisothermal experiment with a heating rate of 20 C/min. Model predictions compare reasonably well with a separate nonisothermal TGA weight loss experiment with a heating rate of 200 C/min.
NTIS
Decomposition; Polyurethane Foam; Quantitative Analysis; Temperature Effects; Models

19990039617 Department of Energy, Washington, DC USA
Index of refraction versus oxygen partial pressure for tantalum oxide and silicon dioxide films produced by ion beam deposition
Goward, W. D., Department of Energy, USA; Petersen, H. E., Department of Energy, USA; Dijaili, S. P., Department of Energy, USA; Walker, J. D., Department of Energy, USA; Apr. 30, 1998; 7p; In English; Sponsored by Society of Vacuum Coaters, USA
Report No.(s): DE98-056042; UCRL-JC-128666; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Tantalum oxide and silicon oxide films were made using an ion beam sputtering system. It was found that even though these films were deposited from oxide targets, additions of oxygen were necessary to achieve stoichiometry and hence index of refraction. It was observed that the tantalum oxide target changed color from white to gray, indicating that the oxygen was being depleted from the target. The addition of oxygen to the chamber during deposition replenished the target and improved film stoichiometry. The deposition rate decreased with increasing oxygen partial pressure. It was experimentally determined that by varying the oxygen partial pressure and keeping all other variables fixed, the index of refraction of the film changed in a predictable manner. That is, as the oxygen partial pressure was increased, the index decreased rapidly initially and then reached a saturation point where it stayed fixed with oxygen content. With this data a coating process can be set up using the minimum amount of oxygen (thus increasing filament lifetime) to produce a fully stoichiometric film that has a fixed index. This paper will present the details of these observations and results.
NTIS
Tantalum Oxides; Silicon Oxides; Sputtering; Oxygen; Partial Pressure; Refractivity; Oxide Films; Deposition

19990040185 Northeastern Univ., Dept. of Physics, Boston, MA USA
Vapor-Phase Lubricants: Nanometer-Scale Mechanisms and Applications to Sub-Micron and Rotating Machinery *Final Report, 15 Jan. 1995 - 30 Nov. 1998*
Krim, Jacqueline; Feb. 28, 1999; 7p; In English
Contract(s)/Grant(s): F49620-98-1-0201
Report No.(s): AD-A361295; AFRL-SR-BL-TR-99-0097; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Vapor-phase lubricants: Nanometer-scale mechanisms and applications to sub-micron and rotating machinery was the beginning segment of a new program supported by AFOSR involving a set of experiments seeking to explore the molecular-scale properties of vapor-phase lubricants in well-defined contact geometries. During the 10.5 month grant period, two ultra-high vacuum chambers were customized for the specific proposed studies, and all personnel involved were trained in Ultra-High Vacuum (UHV) and quartz microbalance techniques. The construction and training period is now complete, and a series of measurements have been performed. These include measurements of the uptake rate of the lubricant TBPP on Fe as a function of temperature, and a series of measurements of the nanomechanical properties of a number of potential lubricants for Micro-Electro-Mechanical Systems (MEMS) applications by means of a combined quartz microbalance/scanning tunneling microscopy technique.
DTIC
Vapor Phases; Lubricants; Scanning Tunneling Microscopy; Microbalances

19990040248 Yale Univ., Dept. of Mechanical Engineering, New Haven, CT USA
Nucleation and Growth Mechanisms Underlying the Microstructure of Polymer Foams Produced by Dynamic Decompression and Cooling
Apfel, Robert, Yale Univ., USA; Wu, David, Yale Univ., USA; NASA Microgravity Materials Science Conference; February 1999, pp. 39-44; In English; See also 19990040241; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

The control of the microstructures of lightweight polymers, polymer blends, polymer-metal composites, and amorphous metals depends in large part on the procedures by which these materials are created and on an understanding of the nucleation and growth mechanisms underlying these procedures. We are further developing a novel approach for producing lightweight, foam structures - Dynamic Decompression and Cooling (DDC) - and using this approach for systematically providing data to new models for the underlying nucleation and growth mechanisms. DDC involves heating and mixing polymer (and/or other source) materials under pressure in the presence of a volatile phase. Non condensable gas super-pressurizes the mixture. The rapid decompression of this mixture results in the boiling of the volatile phase (aided by the supersaturation of the non-condensable

gas), and the cooling of the melt due to latent heat of vaporization of the volatile phase. The result is a solid, open-foam structure of low density possessing microstructures that differ greatly from those commonly found in polyethylene and polypropylene foams commercially available. The reasons for the difference stem from the greatly different nucleation and growth mechanisms as compared to extruded foams. These mechanisms are shrouded in the complexity of the process. In particular, there are several nucleation and growth mechanisms occurring in a short period of time. Upon decompression, there is supersaturation of the non-condensable gas and superheating of the volatile phase. Bubble nucleation and growth follow, controlled by evaporation of the volatile phase and diffusion of the non-condensable phase. Supercooling of the melt occurs as the volatile phase takes its latent heat of vaporization from the melt. Growth is dependent on transport properties including the temperature-dependent viscosity and heat conductivity. Solidification may or may not involve a latent heat of fusion depending on whether crystallization occurs or an amorphous phase is formed. In order to understand these nucleation and growth mechanisms, we must be able to vary the operating parameters over a wide range, and we must be able to follow the transient process in detail. Therefore, we shall use high speed video to record the process, which occurs in a fraction of a second, and to instrument the cell to record the time-dependent temperature and pressure in the mixture as it is decompressed. This data will provide input to the theoretical formalism, and will complement post-analysis data ranging from mechanical testing to electron micrographs and x-ray diffraction. We shall document the conditions at which the structure of foams changes from closed cell to open cell, and we shall correlate microstructure with nucleation and growth mechanisms. The microgravity environment may aid in providing idealized conditions for such tests. In particular, phase separation, and layering and stratification effects are minimized so that uniform initial states can be achieved prior to decompression. Also, non-uniform heating produces convective effects that are absent in zero-g, allowing for the study of transient processes and the resulting foams, which should be isotropic. These considerations are especially important when considering polymer blends and polymer-metal composites intended for high temperature applications (e.g. significantly above 200 C) because of phase separation and density stratification effects. Ground-based studies will provide a baseline for future microgravity work.

Author

Nucleation; Microstructure; Polymer Blends; Foams; Pressure Reduction; Cooling

19990040256 California Inst. of Tech., Div. of Chemistry and Chemical Engineering, Pasadena, CA USA

Dispersion Microstructure and Rheology in Ceramics Processing

Brady, J. F., California Inst. of Tech., USA; NASA Microgravity Materials Science Conference; February 1999, pp. 95-100; In English; See also 19990040241; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

Ceramics provide a potentially very useful class of materials owing to their physical properties; they are light, hard, resistant to abrasion, chemically inert, stable at high temperatures, and excellent thermal and electrical insulators. Further, by casting from a liquid suspension and subsequently sintering, many complex parts and shapes can be fabricated. Although the resultant properties of ceramics can be outstanding, they often suffer from extreme brittleness. This brittleness is caused by the propagation of cracks, which is in turn due to microstructural defects. These defects may be caused by a number of different factors, such as particle agglomeration, migration or segregation prior to sintering, or due to inhomogeneous volume change upon sintering. If a ceramic's microstructure can be controlled and rendered homogeneous prior to (and after) sintering optimal material properties may be realized in an economic way. Typically, high-performance ceramics are produced using monodisperse submicron-sized particulate suspensions from which the ceramics are cast. by controlling the size and processing a dense uniform microstructure may be formed prior to sintering. This route has met with limited success even though the maximum volume fraction of ceramic particulates that can be achieved prior to sintering is 0.74. The limited success may stem from the fact that a perfect crystal of mono-sized particles has slip planes that yield easily, and from the fact that there is still a large amount of void space that must be eliminated upon sintering. An alternate approach is to use a mixture of particle sizes. It is well known that solids fractions of 90% can be obtained with a bidisperse suspension of spherical particles. Even greater loadings are possible with tridisperse systems. Crystalline slip planes can be eliminated with a mixture of particle sizes. In addition to achieving high solids fractions, and therefore reducing potential sintering inhomogeneities, a mixture of two different types of particles can also impart desirable properties in a 'composite' ceramic. For example, zirconia in alumina has been used to arrest crack propagation owing to the transformation toughening of zirconia under stress. of critical importance for processing is the fact that particles that differ in size or composition are subject to gravitational phase separation. Hence, processing in a gravity-reduced environment offers substantial benefits. Research objectives, results, future work and several figures related to bidisperse ordering, shear thinning and scaled viscosities are presented.

Derived from text

Ceramics; Microstructure; Rheology; Brittleness; Crack Propagation

19990040259 Tufts Univ., Dept. of Physics and Astronomy, Medford, MA USA

Effects of Melt Processing on Evolution of Structure in PEEK

Georgiev, Georgi, Tufts Univ., USA; Dai, Patrick Shuanghua, Tufts Univ., USA; Oyebode, Elizabeth, Tufts Univ., USA; Cebe, Peggy, Tufts Univ., USA; Capel, Malcolm, Brookhaven National Lab., USA; NASA Microgravity Materials Science Conference; February 1999, pp. 107-108; In English; See also 19990040241

Contract(s)/Grant(s): NAG8-1167; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche; Abstract Only; Abstract Only

We report on the effects of melt processing temperature on structure formation in Poly(ether-ether-ketone), PEEK. Real time Small Angle X-ray Scattering, SAXS, and thermal analysis are used to follow the melting behavior after various stages of processing. Assignment of peaks to structural entities within the material, the relative perfection of the crystals, and the possibility of their reorganization, are all influenced by the melt processing history. With the advent of high intensity synchrotron sources of X-radiation, polymer scientists gain a research tool which, when used along with thermal analysis, provides additional structural information about the crystals during growth and subsequent melting. PEEK is an engineering thermoplastic polymer with a very high glass transition temperature (145 C) and crystal melting point (337 C). PEEK has been the subject of recent studies by X-ray scattering in which melt and cold crystallization were followed in real-time. X-ray scattering and thermal studies have been used to address the formation of dual endothermic response which has been variously ascribed to lamellar insertion, dual crystal populations, or melting followed by re-crystallization. Another important issue is whether all of the amorphous phase is located in interlamellar regions, or alternatively whether some is located in ”pockets” away from the crystalline lamellar stacks. The interpretation of scattering from lamellar stacks varies depending upon whether such amorphous pockets are formed. Some groups believe all of the amorphous phase is interlamellar. This leads to selection of a smaller thickness for the crystals. Other groups suggest that most amorphous phase is not interlamellar, and this leads to the suggestion that the crystal thickness is larger than the amorphous layer within the stacks. to investigate these ideas, we used SAXS and Differential Scanning Calorimetry to compare results of single and dual stage melt crystallization of PEEK using a treatment scheme involving annealing/crystallization at T(sub a1) followed by annealing at T(sub a2) where either T(sub a1) less than T(sub a2) or T(sub a1) greater than T(sub a2). We proposed a model to explain multiple melting endotherms in PPS, treated according to one or two-stage melt or cold crystallization. Key features of this model are that multiple endotherms: (1) are due to reorganization/recrystallization after cold crystallization; and, (2) are dominated by crystal morphology after melt crystallization at high T. In other words, multiple distinct crystal populations are formed by the latter treatment, leading to observation of multiple melting. PEEK 45OG pellets (ICI Americas) were the starting material for this study. Films were compression molded at 400 C, then quenched to ice water. Samples were heated to 375 C in a Mettler FP80 hot stage and held for three min. to erase crystal seeds before cooling them to T(sub a1) = 280 C . Samples were held at T(sub a2) for a period of time, then immediately heated to 360 C. In the second treatment samples were held at T(sub a1) = 31 C for different crystallization times t(sub c) then cooled to 295 C and held 15 min. In situ (SAXS) experiments were performed at the Brookhaven National Synchrotron Light Source with the sample located inside the Mettler hot stage. The system was equipped with a two-dimensional position sensitive detector. The sample to detector distance was 172.7 cm and the X-ray wavelength was 1.54 Angstroms. SAXS data were taken continuously during the isothermal periods and during the heating to 360 C at 5 C/min. Each SAXS scan was collected for 30 sec. Since the samples were isotropic, circular integration was used to increase the signal to noise ratio. After dual stage melt crystallization with T(sub a1) less than T(sub a2) the lower melting endotherm arises from holding at T(sub a1). During cooling a broad distribution of crystals forms, and the low-melting tail is perfected during T(sub al). Heating to T(sub a2) melts these imperfect crystals and allows others with greater average long spacing to form in their place. After dual stage crystallization with T(sub a1) greater than T(sub a2), the amount of space remaining for additional growth at T(sub a2) depends upon the holding time at T(sub a1). The long period of crystals formed at T(sub a2) is smaller than that formed at T(sub a1) due to growth in a now-restricted geometry. Perfection of crystals is seen as an increase of the intensity of the population scattering at higher s, while the intensity of the population scattering at lower s stays constant. During heating from below to above the minor endotherm, we see rapid decrease of the intensity of the X-ray scattering corresponding to the population of crystals scattering in the shoulder. Another important observation is that after the sample is annealed at 295 C, the shoulder intensity is restored once again. The population scattering at higher s remains longer before it disappears in the sample treated to the second stage of melt crystallization, compared to the sample crystallized with a single stage. This could be interpreted as an effect of continued perfection of the less perfect population, which is also reflected in the increased melting temperature of the smaller endotherm as the holding time at 295 C increases. In the corresponding DSC scans we see a shift in the area and the peak temperature of the lower melting endotherm with an increase of the annealing time.

Author

Crystal Growth; PEEK; Temperature Effects; Crystallization; Crystal Defects; Melts (Crystal Growth)

19990040262 Wisconsin Univ., Dept. of Materials Science and Engineering, Madison, WI USA

Dynamic Reduction and the Creation of Fine-Grained Ceramics From Inviscid Oxide/Silicate Melts

Cooper, Reid F., Wisconsin Univ., USA; NASA Microgravity Materials Science Conference; February 1999, pp. 125-126; In English; See also 19990040241; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

The overall materials science objectives of this research program are to discern, characterize, and develop a useful approach to the creation of fine-grained ceramics from inviscid (low-viscosity) ionic melts. The scientific problem centers on the need to control the density and spatial distribution of crystalline nuclei in such melts. The authors have identified a new, unique ”alternative” approach to controlled nucleation, for which microgravity containerless processing is required: dynamic reduction. In transition-metal-cation-bearing, multicomponent ionic melts, the redox dynamics are such that relatively rapid processing is possible. Derived from text

Ceramics; Oxidation-Reduction Reactions; Containerless Melts; Inviscid Flow; Crystallinity; Crystal Growth; Nucleation; Ionic Crystals; Transition Metals

19990040274 Virginia Commonwealth Univ., Dept. of Chemistry, Richmond, VA USA

Gas Phase Polymerization and Nucleation Experiments in Microgravity

El-Shall, M. Samy, Virginia Commonwealth Univ., USA; NASA Microgravity Materials Science Conference; February 1999, pp. 187-192; In English; See also 19990040241; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

The proposed research is focused on two categories namely, gas phase aerosol droplets polymerization and vapor to liquid homogeneous nucleation. The study of gas phase polymerization is an important intellectual and technological frontier which promises unique results not only for a fundamental understanding of polymerization reactions, but also for the development of new materials with unique properties. In the past it has been almost impossible to study gas phase chain polymerization because the involatile product molecules condensed out of the gas phase. The application of microgravity to the study of gas phase polymerization is expected to result in a better control of the process and may also lead to important technological advances. The growth of nuclei in supersaturated vapors under microgravity conditions is expected to provide a more accurate and reliable picture of the growth process that can now be used to test the validity of different nucleation theories. This is the second objective of the proposed research.

Derived from text

Aerosols; Microgravity; Nucleation; Polymerization; Space Processing; Vapor Phases

19990040275 NASA Marshall Space Flight Center, Huntsville, AL USA

Exploiting the Temperature/Concentration Dependence of Magnetic Susceptibility to Control Convection in Fundamental Studies of Solidification Phenomena

Evans, J. W., California Univ., USA; Xu, Dong, California Univ., USA; Jones, W. Kinzy, Jr., California Univ., USA; Szofran, Frank R., NASA Marshall Space Flight Center, USA; NASA Microgravity Materials Science Conference; February 1999, pp. 193-198; In English; See also 19990040241; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

The objective of this new research project is to demonstrate by experiment, supplemented by mathematical modeling and physical property measurement, that the effects of buoyancy driven convection can be largely eliminated in ground-based experiments, and further reduced in flight, by applying a new technique. That technique exploits the dependence of magnetic susceptibility on composition or temperature. It is emphasized at the outset that the phenomenon to be exploited is fundamentally and practically different from the magnetic damping of convection in conducting liquids that has been the subject of much prior research. The concept suggesting this research is that all materials, even non-conductors, when placed in a magnetic field gradient, experience a force. of particular interest here are paramagnetic and diamagnetic materials, classes which embrace the ”model alloys”, such as succinonitrile-acetone, that have been used by others investigating the fundamentals of solidification. Such alloys will exhibit a dependence of susceptibility on composition. The consequence is that, with a properly oriented field (gradient) a force will arise that can be made to be equal to, but opposite, the buoyancy force arising from concentration (or temperature) gradients. In this way convection can be stilled. The role of convection in determining the microstructure, and thereby properties, of materials is well known. Elimination of that convection has both scientific and technological consequences. Our knowledge of diffusive phenomena in solidification, phenomena normally hidden by the dominance of convection, is enhanced if we can study solidification of quiescent liquids. Furthermore, the microstructure, microchemistry and properties of materials (thereby practical value) are affected by the convection occurring during their solidification. Hitherto the method of choice for elimination of convection has been experimentation in microgravity. However, even in low Earth orbit, residual convection has effects. That residual convection arises from acceleration (drag on the spacecraft), displacement from the center of mass or transients in the gravitational field (g-jitter). There is therefore a need for both further reducing buoyancy driven flow in flight and allowing the simulation of

microgravity during ground based experiments. Previous investigations, the research project description, theory behind the study and experimental methods as well as plots of magnetic fields and forces are presented.
Derived from text
Buoyancy; Convection; Solidification; Magnetic Fields; Microgravity

19990040288 Colorado Univ., Dept. of Chemical Engineering, Boulder, CO USA
Influence of Solutocapillary Convection on Macrovoid Defect Formation in Polymeric Membranes
Konagurthu, Sanjay, Colorado Univ., USA; Pekny, Matthew R., Colorado Univ., USA; Todd, Paul, Colorado Univ., USA; Greenberg, Alan R., Colorado Univ., USA; Krantz, William B., Colorado Univ., USA; NASA Microgravity Materials Science Conference; February 1999, pp. 277-282; In English; See also 19990040241; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

The majority of polymeric membranes can be formed via a phase separation/inversion process by which a polymer solution (in which the solvent is the continuous phase) inverts into a swollen three-dimensional macromolecular network or gel (where the polymer is the continuous phase). Polymeric membranes, formed by a phase-inversion process in a thin-film solution cast on a smooth surface, are rich in structure which strongly influences their selective permeation properties. Certain combinations of properties cannot be achieved owing to the formation of oversized pores called ”macrovoids” (MVs). The presence of MV pores in large numbers can result in compaction and/or collapse of polymeric membranes and hence in a reduction of flux in high pressure applications such as reverse osmosis. Therefore, it is desirable to control the final membrane morphology by optimizing the casting conditions. In order to avoid MV formation, a compromise is made whereby thicker skin layers are tolerated than would be desired to obtain the maximum permeation rates through the membrane. If more could be learned about the nature and causes of MV growth, it might be possible to obtain very thin permselective skin layers while avoiding MV formation. The dry-cast process is the focus of the research. Based on the work done so far, body forces do seem to play a role on macrovoid growth in dry-cast CA membranes. Also, surface tension gradients appear to be responsible for macrovoid growth in these membranes as seen in the surfactant experiments. We propose to combine the effect of varying-g along with the surfactant addition in the upcoming KC-135 flight in October, 1998 to observe the relative effects of body forces vis-a-vis surface tension gradients. This will provide insight into the dominating factor for macrovoid growth. The real-time video microscopy of simulated dry-casting reveals the simultaneous motion of the phase inversion front and the migrating, growing macrovoids using casting solutions of various compositions including surfactants. The MV growth patterns definitely suggest a convective rather than a diffusive process. These experiments are critical for the proposed comprehensive model for macrovoid growth due to solutocapillary flow that combines the experimental measurements with the marangoni convection theory.
Derived from text
Microgravity; Gravitational Effects; Membranes; Polymeric Films; Voids; Surfactants; Convection

19990040334 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA USA
Undercooling Limits and Thermophysical Properties in Glass Forming Alloys
Rhim, Won-Kyu, Jet Propulsion Lab., California Inst. of Tech., USA; Ohsaka, Kenichi, Jet Propulsion Lab., California Inst. of Tech., USA; Spjut, R. Erik, Harvey Mudd Coll., USA; NASA Microgravity Materials Science Conference; February 1999, pp. 547-552; In English; See also 19990040241; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

The primary objective of this program is to produce deeply undercooled metallic liquids and to identify factors that limit undercooling and glass formation. The main research objectives are: (1) Investigating undercooling limits in glass-forming alloys and identifying factors that affect undercooling; (2) Measuring thermophysical properties and investigating the validity of the classical nucleation theory and other existing theories in the extreme undercooled states; and (3) to investigate the limits of electrostatic levitation technology in the ground base and to identify thermophysical parameters that might require reduced-g environment.
Derived from text
Crystal Growth; Nucleation; Levitation Melting; Supercooling; Metallic Glasses; Thermophysical Properties

19990040357 Washington Univ., Seattle, WA USA
Molecular Diffusion in Nonequilibrium Alloy Films and Molecular Motion in Polymeric Networks
Wettlaufer, J. S., Washington Univ., USA; Stone, H. A., Harvard Univ., USA; Elbaum, M., Weizmann Inst. of Science, Israel; Worster, M. G., CamBridge Univ., UK; NASA Microgravity Materials Science Conference; February 1999, pp. 679-684; In English; See also 19990040241; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

We focus on two distinct materials science problems that arise in two distinct microgravity environments: In space and within the space of a polymeric network. In the former environment, we consider a near eutectic alloy film in contact with its vapor which,

when evaporating on earth, will experience compositionally induced buoyancy driven convection. The latter will significantly influence the morphology of the crystallized end member. In the absence of gravity, the morphology will be dominated by molecular diffusion and Marangoni driven viscous flow, and we study these phenomena theoretically and experimentally. The second microgravity environment exists in liquids, gels, and other soft materials where the small mass of individual molecules makes the effect of gravity negligible next to the relatively strong forces of intermolecular collisions. In such materials, an essential question concerns how to relate the molecular dynamics to the bulk rheological behavior. Here, we observe experimentally the diffusive motion of a single molecule in a single polymer filament, embedded within a polymer network and find anomalous diffusive behavior.
Derived from text
Molecular Diffusion; Metal Films; Marangoni Convection; Polymers; Microgravity; Gravitational Effects; Morphology; Crystallization

19990040363 Alabama Univ., Consortium for Materials Development in Space, Huntsville, AL USA
Ground Based Experiments in Support of Microgravity Research Results: Vapor Growth of Organic Nonlinear Optical Thin Films
Zugrav, Maria I., Alabama Univ., USA; Wessling, Francis C., Alabama Univ., USA; Carswell, William E., Alabama Univ., USA; NASA Microgravity Materials Science Conference; February 1999, pp. 711-715; In English; See also 19990040241; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Ordered and oriented thin films of an organic nonlinear optical (NLO) material, N,N-dimethyl-p-(2,2-dicyanovinyl) aniline (DCVA), have been grown on disordered substrates, in space, aboard the USA Space Shuttle Endeavour on STS (Space Transportation System) -59 and STS-69. The STS-69 results extend, confirm, and are consistent with those of the STS-59. Similar experiments have been conducted in the laboratory as ground controls and have produced single crystals only. All experiments have demonstrated that the morphology of DCVA crystals is highly dependent upon gravity. The premise is that the bonds are week in nature (Van der Waals) and are significantly impacted by gravity. Hence, there is a need for a well defined ground-based program to determine the validity of this theory, that is, if the impact of gravitational forces can be overcome by other process parameters. Specifically, the ground-based studies focus on investigating the macroscopic and microscopic conditions required to prepare high-quality thin films of DCVA through the optimization and control of the growth cell orientation, growth temperature, substrate variation studies, and background pressure. The crystal growth experiments have been performed using the Moderate Temperature Facility (MTF). An improved version of the MTF will include the capability of in situ observation of the growth process yielding significant understanding of the mechanisms for two different types of crystal formation, bulk crystals obtained in a normal gravity environment and ordered and oriented thin film crystals obtained in reduced gravity (thin films being achievable only in a reduced gravity environment). The three year old space-only grown DCVA thin films proved to have thermodynamic and photochemical stability. to date, vapor-deposited DCVA thin films have not been duplicated in a normal gravity environment. The space-only grown DCVA thin films are an example of ”Van der Waals epitaxy” on inorganic substrates. Understanding this new growth process is vital if we are to fully exploit its potential to incorporate highly nonlinear optically active organic materials as active opto-electronic and electro-optic components in modern integrated logic device structures.
Derived from text
Vapor Deposition; Thin Films; Microgravity; Gravitational Effects; Optical Materials; Crystal Growth; Organic Materials

19990040364 North Carolina State Univ., Dept. of Physics, Raleigh, NC USA
Investigations of Carbon Nanotube Growth and Mechanical Properties
Bernholc, Jerry, North Carolina State Univ., USA; Roland, Christopher, North Carolina State Univ., USA; NASA Microgravity Materials Science Conference; February 1999, pp. 89-94; In English; See also 19990040241; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

The discovery of carbon nanotubes has revitalized and refocused much of the fullerene research. The interest and excitement in carbon nanotubes derives largely from their unusual structural and electronic properties. Experiments and theory indicate that they are superstrong fibers, with a remarkable resilience to extreme conditions of strain. Simply put, because of the uniqueness of the graphene sp2 bond, carbon nanotubes may be the ultimate strength fibers produced by nature. Furthermore, nanotubes hold considerable promise as composites, catalysts, field emitters, photonic material, molecular straws, molecular devices, and as MicroElectricalMechanical Structures (MEMS) materials, which should allow for unique space-oriented applications. In this brief report, we give a description of some of our recent theoretical investigations of carbon nanotubes, with a focus on aspects

of their growth and mechanical properties. This research has been carried out with a series of complementary theoretical methods covering different length and time scales, including ab initio, classical molecular dynamics and kinetic Monte Carlo simulations. Derived from text

Nanocrystals; Nanostructure (Characteristics); Mechanical Properties; Carbon Fibers

19990040387 Department of Energy, Assistant Secretary for Management and Administration, Washington, DC USA

Comparison of dry-etch techniques for GaN, InN, and AlN

Shul, R. J., Department of Energy, USA; Vawter, G. A., Department of Energy, USA; Willison, C. G., Department of Energy, USA; Bridges, M. M., Department of Energy, USA; Lee, J. W., Department of Energy, USA; Dec. 31, 1997; 9p; In English; Sponsored by Materials Research Society, USA

Report No.(s): DE98-003054; SAND-98-0335C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Fabrication of group III nitride devices relies on the ability to pattern features to depths ranging from 1000 a to (gt) 5 microns with anisotropic profiles, smooth morphologies, selective etching of one material over another, and a low degree of plasma induced damage. In this study, gan etch rates and etch profiles are compared using reactive ion etch (RIE), reactive ion beam etching (RIBE), electron cyclotron resonance (ECR), and inductively coupled plasma (ICP) etch systems. RIE yielded the slowest etch rates and sloped etch profiles despite DC-Biases (gt) -900 V. ECR and ICP etching yielded the highest rates with anisotropic profiles due to their high plasma flux and the ability to control ion energies independently of plasma density. RIBE etch results also showed anisotropic profiles with slower etch rates than either ECR or ICP possibly due to lower ion flux. InN and AlN etch characteristics are also compared using ICP and RIBE.

NTIS

Drying; Etching; Gallium Nitrides; Indium Compounds; Aluminum Nitrides

19990040420 Ceskoslovenska Akademie Ved, Inst. of Physics, Prague, Czechoslovakia

Intergranular and Interphase Boundaries in Materials (IIB 1998)

Lejcek, Pavel, Editor; Paidar, Vaclav, Editor; Jan. 1999; 831p; In English; 9th, 6-9 Jul. 1998, Prague, Czechoslovakia

Contract(s)/Grant(s): N00014-98-1-1020

Report No.(s): AD-A361390; No Copyright; Avail: CASI; A99, Hardcopy; A10, Microfiche

The 9th International Conference on Intergranular and Interphase Boundaries in Materials (iib'98) held on 6-9 July 1998 in Prague, Czech Republic, represents a successful continuation of the series of this Conference starting by the first meeting in Saint Etienne, France, in 1975. Following the scope of the preceding meetings, this Conference was focused on atomic level modeling of interfaces, structural and chemical characterization of internal interfaces, their thermodynamic, kinetic, mechanical, electric, magnetic behavior and high-Tc superconductivity, and application of present knowledge for design of polycrystalline materials with improved properties. More than 200 scientists from 27 countries of four continents actively participated in the meeting. Traditionally, a special symposium on an actual topic has been organized as a part of the Conference: During iib'98, the attention was paid to Non-Equilibrium Segregation in Irradiated Materials. A particular session was devoted to presentation of the results obtained during the International Cooperation in Science and Technology (COST). The contributions presented at the IIB'98 are published in this volume. Nearly 200 papers that cover all above mentioned topics were presented as invited talks, oral contributions and - in the vast majority - posters. These papers bring new results in the study of interfaces and their properties obtained in the last years, and represent the present state of the art in this field. We are grateful to all referees for their assistance in preparation of this volume.

DTIC

Conferences; Alloys; Grain Boundaries; Ceramic Bonding; Superconductivity; Mechanical Properties; Polycrystals; Atomic Structure

19990040430 NASA Glenn Research Center, Cleveland, OH USA

Plumbrook Hypersonic Tunnel Facility Graphite Furnace Degradation Mechanisms

Jacobson, Nathan S., NASA Glenn Research Center, USA; March 1999; 18p; In English

Contract(s)/Grant(s): RTOP 523-61-23

Report No.(s): NASA/TM-1999-208907; NAS 1.15:208907; E-11520; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A recent rebuild revealed extensive degradation to the large graphite induction furnace in the Hypersonic Tunnel Facility (HTF). This damage to the graphite blocks and insulating felt is examined and modeled with thermochemical equilibrium codes. The primary reactions appear to be with water vapor and the nitrogen purge gas. Based on these conclusions, several changes are

recommended. An inert purge gas (e.g. argon or helium) and controlling and monitoring water vapor to about 10 ppm should decrease the damage substantially.
Author
Graphite; Furnaces; Hypersonic Wind Tunnels

19990040469 NASA Goddard Space Flight Center, Greenbelt, MD USA
Statistical Evaluation of Molecular Contamination During Spacecraft Thermal Vacuum Test
Chen, Philip, NASA Goddard Space Flight Center, USA; Hedgeland, Randy, NASA Goddard Space Flight Center, USA; Montoya, Alex, NASA Goddard Space Flight Center, USA; Roman-Velazquez, Juan, NASA Goddard Space Flight Center, USA; Dunn, Jamie, NASA Goddard Space Flight Center, USA; Colony, Joe, ManTech Systems Engineering Corp., USA; Petitto, Joseph, Naval Surface Warfare Center, USA; 20th Space Simulation Conference: The Changing Testing Paradigm; February 1999, pp. 35-46; In English; See also 19990040464; No Copyright; Avail: CASI; A03, Hardcopy; A03, Microfiche

The purpose of this paper is to evaluate the statistical molecular contamination data with a goal to improve spacecraft contamination control. The statistical data was generated in typical thermal vacuum tests at the National Aeronautics and Space Administration, Goddard Space Flight Center (GSFC). The magnitude of material outgassing was measured using a Quartz Crystal Microbalance (QCNO device during the test. A solvent rinse sample was taken at the conclusion of each test. Then detailed qualitative and quantitative measurements were obtained through chemical analyses. All data used in this study encompassed numerous spacecraft tests in recent years.
Author
Chemical Analysis; Spacecraft Contamination; Statistical Analysis; Thermal Vacuum Tests; Outgassing; Polymers

19990040482 NASA Marshall Space Flight Center, Huntsville, AL USA
Radiation Induced Degradation of White Thermal Control Paint
Edwards, D. L., NASA Marshall Space Flight Center, USA; Zwiener, J. M., NASA Marshall Space Flight Center, USA; Wertz, G. E., NASA Marshall Space Flight Center, USA; Vaughn, Jason A., NASA Marshall Space Flight Center, USA; Kamenetzky, Rachel R., NASA Marshall Space Flight Center, USA; Finckenor, M. M., NASA Marshall Space Flight Center, USA; Meshishnek, M. J., Aerospace Corp., USA; 20th Space Simulation Conference: The Changing Testing Paradigm; February 1999, pp. 207-218; In English; See also 19990040464; No Copyright; Avail: CASI; A03, Hardcopy; A03, Microfiche

This paper details a comparison analysis of the zinc-oxide pigmented white thermal control paints Z-93 and Z-93P. Both paints were simultaneously exposed to combined space environmental effects and analyzed using an in-vacuo reflectance technique. The dose applied to the paints was approximately equivalent to 5 yr in a geosynchronous orbit. This comparison analysis showed that Z-93P is an acceptable substitute for Z-93. Irradiated samples of Z-93 and Z-93P were subjected to additional exposures of ultraviolet (UV) radiation and analyzed using the in-vacuo reflectance technique to investigate UV activated reflectance recovery. Both samples showed minimal UV activated reflectance recovery after an additional 190 equivalent Sun hour (ESH) exposure. Reflectance response utilizing nitrogen as a repressurizing gas instead of air was also investigated. This investigation found the rates of reflectance recovery when repressurized with nitrogen are slower than when repressurized with air.
Author
Aerospace Environments; Environment Effects; Paints; Reflectance; Temperature Control; Zinc Oxides; Ultraviolet Radiation

19990040483 NASA Goddard Space Flight Center, Greenbelt, MD USA
On-Orbit Teflon(trademark) FEP Degradation
Townsend, Jacqueline, NASA Goddard Space Flight Center, USA; Hansen, Patricia A., NASA Goddard Space Flight Center, USA; Dever, Joyce A., NASA Lewis Research Center, USA; 20th Space Simulation Conference: The Changing Testing Paradigm; February 1999, pp. 219-232; In English; See also 19990040464; No Copyright; Avail: CASI; A03, Hardcopy; A03, Microfiche

During the Hubble Space Telescope (HST) Second Servicing Mission (SM2), degradation of unsupported Teflon(trademark) FEP (fluorinated ethylene propylene), used as the outer layer of the multi-layer insulation (MLI) blankets, was evident as large cracks on the telescope light shield. A sample of the degraded outer layer was retrieved during the mission and returned to Earth for ground testing and evaluation. The results of the Teflon(trademark) FEP sample evaluation and additional testing of pristine Teflon FEP led the investigative team to theorize that the HST damage was caused by thermal cycling with deep-layer damage from electron and proton radiation which allowed the propagation of cracks along stress concentrations, and that the damage

increased with the combined total dose of electrons, protons, UV and x-rays along with thermal cycling. This paper discusses the testing and evaluation of the Teflon(trademark) FEP.
Author
Electron Radiation; Protons; Teflon (Trademark); X Rays; Environmental Tests; Cracks; Radiation Shielding; Thermal Degradation; Ultraviolet Radiation; Multilayer Insulation

19990040484 Karpov (V. Y.) Physical Chemistry Inst., Obninsk, Russia
Ground Simulation of Space Radiation Effects on Nonmetallic Materials: Status of the Proposed ISO Standard
Briskman, Boris A., Karpov (V. Y.) Physical Chemistry Inst., Russia; Borson, Eugene N., Borson (E. N.), USA; 20th Space Simulation Conference: The Changing Testing Paradigm; February 1999, pp. 233-246; In English; See also 19990040464; No Copyright; Avail: CASI; A03, Hardcopy; A03, Microfiche

Russia has proposed new international standard for the testing of nonmetallic materials to simulate space radiation effects. The proposal was submitted to ISO (the International Organization for Standards) Technical Committee 20 (Aircraft and Space Vehicles), Subcommittee 14 (Space Systems and Operations) and was approved as Working Draft 15856 at the Los-Angeles meeting (1997). The second version of the draft was approved at the Beijing meeting (1998).
Author
Simulation; Materials Tests; Spacecraft Construction Materials; Standards; Aerospace Environments; Radiation Effects; Polymer Matrix Composites; Environmental Tests; Glass

19990040485 NASA Goddard Space Flight Center, Greenbelt, MD USA
Degradation of Teflon(trademark) FEP Following Charged Particle Radiation and Rapid Thermal Cycling
Townsend, Jacqueline, NASA Goddard Space Flight Center, USA; Powers, Charles, NASA Goddard Space Flight Center, USA; Viens, Michael, NASA Goddard Space Flight Center, USA; Ayres-Treusdell, Mary, NASA Goddard Space Flight Center, USA; Munoz, Bruno, Unisys Corp., USA; 20th Space Simulation Conference: The Changing Testing Paradigm; February 1999, pp. 247-255; In English; See also 19990040464; No Copyright; Avail: CASI; A02, Hardcopy; A03, Microfiche

During the Second Servicing Mission (SM2) of the Hubble Space Telescope (HST) severe degradation was observed on the outer layer of the thermal control blankets. Astronaut observations and photographs revealed large cracks in the metallized Teflon(trademark) FEP (fluorinated ethylene propylene), the outer layer of the multi-layer insulation (MLI), in many locations around the telescope. In an effort to understand what elements of the space environment might cause such damage, pristine Teflon(trademark) FEP was tested for durability to radiation and thermal cycling. Specimens were subjected to electron and proton fluences comparable to those experienced by HST and were subsequently thermal cycled in a custom-built rapid thermal cycle chamber. Tensile tests of the specimens showed that radiation followed by thermal cycling significantly reduced the ultimate strength and elongation of Teflon(trademark) FEP.
Author
Aerospace Environments; Cracks; Multilayer Insulation; Teflon (Trademark); Tensile Tests; Thermal Cycling Tests; Protons; Electrons

19990040486 NASA Lewis Research Center, Cleveland, OH USA
Effect of X-Rays on the Mechanical Properties of Aluminized FEP Teflon(trademark)
Gaier, James R., NASA Lewis Research Center, USA; Brinkmeier, Michael R., Manchester Coll., USA; Gaier, Elizabeth M., Manchester Coll., USA; 20th Space Simulation Conference: The Changing Testing Paradigm; February 1999, pp. 257-268; In English; See also 19990040464
Contract(s)/Grant(s): NCC3-317; No Copyright; Avail: CASI; A03, Hardcopy; A03, Microfiche

Pieces of the multilayer insulation (MLI) that is integral to the thermal control of the Hubble Space Telescope (HST) have been returned by two servicing missions after 3.6 and 6.8 years in orbit. They reveal that the outer layer, which is made from 5 mil (0.13 mm) thick aluminized fluorinated ethylenepropylene (FEP) Teflon. has become severely embrittled. Although possible agents of this embrittlement include electromagnetic radiation across the entire solar spectrum, trapped particle radiation, atomic oxygen, and thermal cycling, intensive investigations have not yielded unambiguous causes. Previous studies utilizing monoenergetic photons in the 69-1900 eV range did not cause significant embrittlement, even at much higher doses than were experienced by the HST MLI. Neither did x-rays in the 3 to 10 keV range generated in a modified electron bean evaporator. An antidotal aluminized FEP sample that was exposed to an intensive dose from unfiltered Mo x-ray radiation from a rotating anode generator, however, did show the requisite embrittlement. Thus, a study was undertaken to determine the effects of x-ray exposure on the embrittlement of aluminized FEP in hopes that it might elucidate the HST MLI degradation mechanism. Tensile specimens of aluminized 5 mil thick FEP were exposed to a constant fluence of unfiltered x-ray radiation from a Mo target whose maximum

energy ranged from 20-60 kV. Other samples were annealed, thermally cycled (100x) between 77-333 K, or cycled and irradiated. Tensile tests and density measurements were then performed on the samples. Only the samples which had been irradiated had the drastically reduced elongation-to-break, characteristic of the HST samples. Thermal cycling may accelerate the embrittlement, but the effect was near the scatter in the measurements. Annealing and thermal cycling had no apparent effect. Only the samples which had been irradiated and annealed showed significant density increases, likely implicating polymer chain scission and annealing.
Author
Aluminum; Annealing; Embrittlement; Irradiation; Multilayer Insulation; Teflon (Trademark); X Rays; Mechanical Properties; Thermal Cycling Tests; Cleavage

19990040549 Search for Extraterrestrial Intelligence Inst., Mountain View, CA USA
Prebiotic Polymer Synthesis and the Origin of Glycolytic Metabolism ***Final Report, 1 Dec. 1992 - 30 Nov. 1998***
Weber, Arthur L., Search for Extraterrestrial Intelligence Inst., USA; 1998; 84p; In English
Contract(s)/Grant(s): NCC2-784; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

Our research resulted in several discoveries which contributed to understanding the origin and operation of life. (1) Most importantly, we discovered a new pathway of prebiotic amino acid synthesis in which formaldehyde and glycolaldehyde (formose reaction substrates) react with ammonia to give alanine and homoserine in the presence of thiol catalysts. The thiol-dependent synthesis of amino acids undoubtedly occurs via amino acid thioester intermediates capable of forming peptides. This 'one-pot' reaction system operates under mild aqueous conditions, and like modern amino acid biosynthesis, uses sugar intermediates which are converted to amino acids by energy-yielding redox disproportionation. Preliminary evidence suggests that this type of process can be "evolved" by a serial transfer methods that lead to enrichment of autocatalytic molecules. (2) We established that prebiotic peptide polymers can be made by condensation of amino acid thioesters (homocysteine thiolactone and S-(N-beta-orotidyl- diaminopropionic acid) ethanethiol), and that prebiotic polydisulfide polymers can be generated by oxidation of dithiols with iron(III) in minerals. (3) In our analysis of metabolism we discovered the primary energy source of biosynthesis -- chemical energy made available by the redox disproportionation of substrate carbon groups. We concluded that the energy and reactivity of sugars make them the optimal substrate for the origin and operation of terrestrial (or extraterrestrial) life. (4) Since it is likely that the use of optimal sugar substrates in biosynthesis sets the average oxidation number of functional biocarbon throughout the Universe near 0.0 (the reduction level of formaldehyde), we proposed that a line(s) in the microwave spectrum of formaldehyde could be rationally selected as a frequency for interstellar communication that symbolizes life. (5) Finally, in preparation for the analysis of Martian meteorite samples, we upgraded our HPLC system to one femtomole sensitivity, and developed a new electrophoretic method of sample preparation for HPLC analysis of the meteoritic amino acids. In a sample of the KT boundary layer from Sussex Wyoming, we found about 300 picomoles per gram of meteoritic alpha-aminoisobutyric acid per gram of KT layer.
Derived from text
Amino Acids; Biological Evolution; Biosynthesis; Extraterrestrial Life; Peptides; Metabolites; Metabolism; Biochemistry; Chemical Evolution; Protein Synthesis; Protobiology; Exobiology; Polymers; Glycolysis

19990040571 Department of Energy, Washington, DC USA
Pressure as a Probe of the Glassy State of Ferroelectrics with Random Site Disorder
Samara, G. A., Department of Energy, USA; Hansen, L. V., Department of Energy, USA; Mar. 10, 1998; 8p; In English; Sponsored by Materials Research Society, USA
Report No.(s): DE98-002807; SAND-97-1683C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Results on lanthanum-modified lead zirconate-titanates (PLZTs) have revealed a pressure-induced crossover from a normal ferroelectric to a relaxation state and the continuous evolution of the dynamics and energetics of the relaxation process. This crossover appears to be a general feature of soft mode ferroelectrics with random site dipolar impurities or polar nanodomains and results from a large decrease in the correlation radius among polar nanodomains -- a unique property of soft mode ferroelectrics. NTIS
Ferroelectric Materials; Ferroelectricity; Lead Zirconate Titanates; Lanthanum

19990040585 Department of Energy, Office of Energy Research, Washington, DC USA
Development of radiation stable plastic scintillator ***Final Report, Jul. 1991 - Jul. 1993***
Jul. 22, 1998; 2p; In English
Report No.(s): DE98-007457; DOE/ER/40547-T1; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The Detector Development Group at the University of Florida has identified the only known optically radiation hard polymer, scintillator and wavelength shifter materials. The authors summarize their findings here. They conducted an extensive study of

siloxane polymers using monomers of dimethyl, diphenyl and methylphenyl siloxanes. An important finding of that study was that polymethylphenylsiloxane is a candidate polymer for use at the SSC. However, the most important result of that work was the demonstration of the existence of optical polymers with extreme resistance to radiation damage. It held out the promise that other possibly more convenient polymers with similar properties could be identified. The first high viscosity, transparent, radiation hard siloxane with high fluor solubility was processed into prototype plates. The authors propose a mechanism to account for radiation induced annealable color center formation in commercial scintillator polymers such as PS and PMMA. The authors produced analogues of these polymers with T(sub g) < room temperatures. These polymers are optically radiation hard. The University of Florida has applied for a patent on this breakthrough discovery. It was found that dye mobility for radiation hard elastomers (T(sub g) < room temperature) was unacceptable over a period of one year. Dyes would tend to crystallize on the surface of the plates. The work concentrated therefore on thermoplastic polymers which had T(sub g) approximately 50 C (i.e., high enough for structural stability) and with high color center annealing rate such as polyisobutylmethacrylate. These polymers were both radiation hard and had minimal dye migration. The University of Florida has a patent on these materials. These materials were extruded and tested for stability and found adequate for operation up to 10 Mrad at the SSC.
NTIS
Scintillation Counters; Radiation; Structural Stability; Thermoplasticity

19990040639 Oak Ridge National Lab., Metals and Ceramics Div., TN USA
Interfacial debonding versus fiber fracture in fiber-reinforced ceramic composites
Hsueh, C. H., Oak Ridge National Lab., USA; Becher, P. F., Oak Ridge National Lab., USA; He, M. Y., Oak Ridge National Lab., USA; Dec. 31, 1998; 6p; In English; 1st; China international conference in high-performance ceramics; Sponsored by Department of Energy, USA
Report No.(s): DE99-000233; ORNL/CP-99522; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Toughening of fiber-reinforced ceramic composites by fiber pullout relies on debonding at the fiber/matrix interface prior to fiber fracture when composites are subjected to tensile loading. The criterion of interfacial debonding versus crack penetration has been analyzed for two semi-infinite elastic plates bonded at their interface. When a crack reaches the interface, the crack either deflects along the interface or penetrates into the next layer depending upon the ratio of the energy release rate for debonding versus that for crack penetration. This criterion has been used extensively to predict interfacial debonding versus fiber fracture for a crack propagating in a fiber- reinforced ceramic composite. Two modifications were considered in the present study to address the debonding/fracture problem. First, the authors derived the analysis for a strip of fiber, which had a finite width and was sandwiched between two semi-infinite plates of matrix. It was found that the criterion of interfacial debonding versus fiber fracture depended on the fiber width. Second, a bridging fiber behind the crack tip was considered where the crack tip initially circumvented the fiber. Subsequent to this, either the interface debonded or the fiber fractured. In this case, the authors have considered a bridging-fiber geometry to establish a new criterion.
NTIS
Debonding (Materials); Fiber Composites; Fiber-Matrix Interfaces; Ceramic Matrix Composites; Cracking (Fracturing)

19990040673 Oak Ridge National Lab., TN USA
Development of chemically vapor deposited mullite coatings for the corrosion protection of SiC
Auger, M., Oak Ridge National Lab., USA; Hou, P., Oak Ridge National Lab., USA; Sengupta, A., Oak Ridge National Lab., USA; Basu, S., Oak Ridge National Lab., USA; Sarin, V., Oak Ridge National Lab., USA; May 01, 1998; 50p; In English; Sponsored by Department of Energy, USA
Report No.(s): DE99-000310; ORNL/SUB-94-SS110/04; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Crystalline mullite coatings have been chemically vapor deposited onto SiC substrates to enhance the corrosion and oxidation resistance of the substrate. Current research has been divided into three distinct areas: (1) Development of the deposition processing conditions for increased control over coating's growth rate, microstructure, and morphology; (2) Analysis of the coating's crystal structure and stability; (3) The corrosion resistance of the Chemical Vapor Deposition (CVD) mullite coating on SiC.
NTIS
Vapor Deposition; Mullites; Corrosion Prevention; Silicon Carbides; Crystal Structure; Oxidation Resistance; Protective Coatings

19990040677 Oak Ridge National Lab., TN USA

Aging of polyurethane foam insulation in simulated refrigerator panels: Initial results with third-generation blowing agents

Wilkes, K. E., Oak Ridge National Lab., USA; Gabbard, W. A., Oak Ridge National Lab., USA; Weaver, F. J., Oak Ridge National Lab., USA; Dec. 31, 1998; 8p; In English; Earth technologies forum; Sponsored by Department of Energy, USA

Report No.(s): DE99-000234; ORNL/CP-99527; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Laboratory data are presented on the effect of constant-temperature aging on the apparent thermal conductivity of polyurethane foam insulation for refrigerators and freezers. The foam specimens were blown with HCFC-141b and with three of its potential replacements -- HFC-134a, HFC-245fa, and cyclopentane. Specimens were aged at constant temperatures of 90 F, 40 F, and -10 F. Thermal conductivity measurements were made on two types of specimens: full-thickness simulated refrigerator panels containing foam enclosed between solid plastic sheets, and thin slices of core foam cut from similar panels. Results are presented for about 250 days of aging for the core-foam specimens and for the first six months of aging for the full-thickness panels.

NTIS

Polyurethane Foam; Refrigerators; Panels; Blowing; Aging (Metallurgy)

19990040699 Sandia National Labs., Encapsulants and Foams Dept., Albuquerque, NM USA

Arylene-Bridged 2,2,5,5-tetramethyl2, 5-disila-1-oxacyclopentanes as precursors to non-shrinking polysiloxanes. A new route to sol-gel type polymers

Rahimian, K.; Loy, D. A.; Dec. 31, 1998; 2p; In English; 216th; Sponsored by American Chemical Society, USA

Report No.(s): DE99-000427; SAND-98-1416C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Sol-gel chemistry has been the focus of much attention in the design and preparation of highly crosslinked polysiloxane gels. Preparation of sol-gel processed silica or polysilesquioxane gels is carried out by the hydrolysis and condensation of alkoxysilyl monomers, usually in the presence of catalytic acid or base and an excess of water. Removal of the alcohol and water byproducts of the condensation reactions, in addition to the alcohol needed to co-dissolve the hydrophobic monomers with water, leads to substantial shrinkage during drying of the resulting gels. This limits the utility of sol-gel processing for applications requiring net-shape casting of artifacts, crack free coatings, or low vaporous organic contaminants (VOCs). It would be advantageous to have a sol-gel process based on an organosilicon monomer that would not require water as a reactant or produce water and alcohol condensation products and still result in siloxane network polymers capable of forming gels. Here, the authors show the synthesis and preparation of a novel sol-gel monomer which can easily be polymerized by ring opening polymerization to give highly crosslinked polysiloxane gels with no condensation byproducts.

NTIS

Alcohols; Shrinkage; Sol-Gel Processes; Polymerization

19990040763 Sandia National Labs., Albuquerque, NM USA

Recent developments in robocasting of ceramics and multimaterial deposition

Cesarano, J.; King, B. H.; Denham, H. B.; Dec. 31, 1998; 8p; In English; Solid freeform fabrication

Report No.(s): DE99-001063; SAND-98-2195C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Robocasting is a freeform fabrication technique for dense ceramics and composites that is based on layer-wise deposition of highly loaded colloidal slurries. The process is essentially binderless with less than 1% organics and parts can be fabricated, dried, and completely sintered in less than 24 hours. This overview highlights recent materials developments for structural applications and modeling of slurry flow. Fabrication of preforms for alumina/metal composites is discussed as well as techniques for multimaterial deposition in both graded structures and discrete placement of fugitive materials.

NTIS

Casting; Ceramics; Deposition; Composite Materials

19990040764 Sandia National Labs., Albuquerque, NM USA

Mechanical behavior of robocast alumina

Denham, H. B.; Cesarano, J.; King, B. H.; Calvert, P.; Dec. 31, 1998; 8p; In English; Solid freeform fabrication

Report No.(s): DE99-001062; SAND-98-2193C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Direct fabrication of alumina parts by robocasting was completed. This method is based on three-dimensional deposition of binderless aqueous alumina slurries. Parts were made with different deposition paths and mechanical testing performed to determine the effects of bead alignment. Properties were also compared to alumina processed more traditionally.

NTIS

Mechanical Properties; Aluminum Oxides; Casting

19990040767 Sandia National Labs., Albuquerque, NM USA

Influence of rheology on deposition behavior of ceramic pastes in direct fabrication systems

King, B. H.; Morissette, S. L.; Denham, H.; Cesarano, J.; Dimos, D.; Dec. 31, 1998; 8p; In English; Solid freeform fabrication

Report No.(s): DE99-001058; SAND-98-2194C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Rheology and deposition behavior of four commercially available thick-film inks and an aqueous alumina slurry were investigated using two different slurry-based deposition systems. The first of these deposition systems, a Micropen, is a commercially available system designed for the deposition of electronic thick film circuits. The second system, referred to as a Robocaster, is a developmental system designed to build thick or structural parts. Slurry rheology was seen to have a minor effect on deposition behavior and the bead shape when deposited using the Micropen. The deposition behavior was instead dominated by drying rate; too rapid of a drying rate led to excessive clogging of the tip. Slurry rheology had a greater impact on the shape of beads deposited using the Robocaster. Highly viscous slurries yielded initially well-defined beads, whereas beads deposited using fluid slurries spread quickly. In both cases, significant spreading occurred with time. These observations only held for slurries with slow drying rates. It was observed that very fluid slurries produced well-defined beads when the drying rate was suitably high.

NTIS

Rheology; Deposition; Ceramics; Pastes; Fabrication

19990040768 TecOne, Inc., Tallahassee, FL USA

Thermoelectric behavior of conducting polymers: On the possibility of off-diagonal thermoelectricity

Mateeva, N.; Testardi, L.; Niculescu, H.; Schlenoff, J.; Dec. 31, 1998; 21p; In English

Report No.(s): DE99-001053; DOE/ER/12171-1; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Non-cubic materials, when structurally aligned, possess sufficient anisotropy to exhibit thermoelectric effects where the electrical and thermal paths can be orthogonal due to off-diagonal thermoelectricity (ODTE). The authors discuss the benefits of this form of thermoelectricity for device applications and describe a search for suitable thermoelectric properties in the air-stable conducting polymers polyaniline and polypyrrole.

NTIS

Thermoelectricity; Conducting Polymers

19990040824 Army Research Lab., Human Research and Engineering Directorate, Aberdeen Proving Ground, MD USA

Evaluation and Characterization of Ceramic Bearing Materials ***Final Report, 1995 - 1998***

Huang, Paul J.; Hubbard, Clifford W.; Gilde, Gary A.; Swab, Jeffrey J.; Mar. 1999; 40p; In English

Report No.(s): AD-A361191; ARL-TR-1910; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report discusses the findings from one phase of our ongoing work to evaluate materials for Army bearing systems. The objective of this phase is to determine the response and longevity of various silicon nitride Si3N4 materials to rolling contact fatigue (RCF) using hybrid and all-ceramic systems. Tests were conducted under regular lubrication and lubrication-starved conditions for extended periods. A correlation between RCF life and the hardness, strength, and microstructure of each silicon nitride is made. The various silicon nitride materials evaluated in these RCF tests were selected on the basis of providing a varied response to the RCF parameters and conditions used.

DTIC

Antifriction Bearings; Microstructure; Ceramics

19990041075 Oak Ridge National Lab., TN USA

Failure probability prediction of dielectric ceramics in multilayer capacitors

Wereszczak, A. A.; Breder, K.; Ferber, M. K.; Bridge, R. J.; Riester, L.; Dec. 31, 1998; 11p; In English; 100th; Annual meeting of the American Ceramic Society

Report No.(s): DE99-000366; ORNL/CP-98893; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Dielectric ceramics in multilayer capacitors are subjected to manufacturing or service thermomechanical stresses which, if severe enough, will cause mechanical failure and perhaps subsequent loss of electrical function. Strength of monolithic ceramics is probabilistic in nature; however, probabilistic design of such electronic ceramic components generally has not been used by manufacturers and end-users of these components. to illustrate how probabilistic design may be utilized for small components, the present study demonstrates the applicability of an existing probabilistic life design computer code in the prediction of failure probability of a dielectric ceramic in an arbitrary multilayer capacitor. Issues involving the generation of representative strength and fatigue data for specimens at this small scale and the ultimate failure probability prediction of dielectric ceramics in multilayer

capacitors are presented. Additionally, alternative means to generate a strength distribution as input for the probabilistic life design computer codes which are under consideration by the authors are discussed.
NTIS
Ceramics; Capacitors; Failure Analysis; Probability Theory; Dielectrics

28
PROPELLANTS AND FUELS

Includes rocket propellants, igniters, and oxidizers; their storage and handling procedures; and aircraft fuels. For related information see also 07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power, and 44 Energy Production and Conversion.

19990040538 Department of Energy, Assistant Secretary for Energy Efficiency and Renewable Energy, Washington, DC USA
Economic and technical analysis of distributed utility benefits for hydrogen refueling stations ***Final Report***
Iannucci, J. J., Department of Energy, USA; Eyer, J. M., Department of Energy, USA; Horgan, S. A., Department of Energy, USA; Schoenung, S. M., Department of Energy, USA; Apr. 30, 1998; 125p; In English
Report No.(s): DE99-000982; DOE/GO/10140-T1; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

This report presents the potential economic benefits of operating hydrogen refueling stations to accomplish two objectives: supply pressurized hydrogen for vehicles, and supply distributed utility generation, transmission and distribution peaking energy and capacity to the utility. The study determined under what circumstances using a hydrogen-fueled generator as a distributed utility generation source, co-located with the hydrogen refueling station components (electrolyzer and storage), would result in cost savings to the station owner, and hence lower hydrogen production costs. The systems studied include a refueling station (including such components as an electrolyzer, storage, hydrogen dispensers, and compressors) plus on-site hydrogen fueled electricity generation units (e.g., fuel cells or combustion engines). The operational strategy is to use off-peak electricity in the electrolyzer to fill hydrogen storage, and to dispatch the electricity generation about one hour per day to meet the utility's local and system peaks. The utility was assumed to be willing to pay for such service up to its avoided generation, fuel, transmission and distribution costs.
NTIS
Hydrogen Production; Hydrogen Fuels; Fuel Cells

19990040702 Nebraska Univ., Mid-America Transportation Center, Lincoln, NE USA
Alternative Fuel Options and Costs for Use in Kansas and Surrounding States
Suppes, G. J., Nebraska Univ., USA; Ponnachath, P., Nebraska Univ., USA; Doris, J., Nebraska Univ., USA; Aggarwal, R., Nebraska Univ., USA; Sep. 1998; 26p; In English
Contract(s)/Grant(s): DTRS95-G-0007
Report No.(s): PB99-123556; MATC-KU97-1; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

To meet state and federal mandates, state fleets, federal fleets, and fuel provider fleets must acquire alternatively fueled vehicles (AFVs). Two pieces of legislation affect fleets in Kansas, the federal Energy Policy Act and the State House Bill 95-2161. Included in this report is information about who must comply with these regulations, what constitutes compliance, tax incentives and AFV availability.
NTIS
Clean Fuels; Alternatives; Costs

19990040820 Environmental Protection Agency, Office of Pollution, Prevention, and Toxics, Washington, DC USA
EPCRA Section 313 Industry Guidance: Petroleum Terminals and Bulk Storage Facilities
Jan. 1999; 114p; In English
Report No.(s): PB99-128761; EPA/745/B-99/066; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

This document is intended to assist establishments and facilities designated by the Standard Industrial Classification (SIC) code 5171 (petroleum bulk stations and terminals) in making compliance determinations under the EPCRA Section 313 reporting requirements and preparing Form R(s) or the Form A certification statement(s) as required. The EPCRA Section 313 program is commonly referred to as the Toxic Chemical Release Inventory (TRI) program. This document is organized to provide a step-by-step guide to compliance with EPCRA Section 313, starting with how you determine if your facility must report through completion of the Form R or Form A.
NTIS
Waste Management; Waste Disposal; Crude Oil; Emission

19990041077 Department of Energy, Office of Energy Markets and End Use, Washington, DC USA

Monthly Energy Review

Dec. 1998; 196p; In English

Report No.(s): PB99-130031; DOE/EIA-0035(98/12); No Copyright; Avail: CASI; A09, Hardcopy; A03, Microfiche

The report presents an overview of the Energy Information Administration's recent monthly energy statistics. The statistics cover the major activities of U.S. production, consumption, trade, stocks, and prices for petroleum, natural gas, coal, electricity, and nuclear energy. Also included are international energy and thermal and metric conversion factors.

NTIS

Management; Electricity; Crude Oil; Natural Gas; Coal; Energy Conservation

29
MATERIALS PROCESSING

Includes space-based development of products and processes for commercial applications. For biological materials see 55 Space Biology.

19990040241 NASA Marshall Space Flight Center, Huntsville, AL USA

NASA Microgravity Materials Science Conference

Gillies, D. C., Compiler, NASA Marshall Space Flight Center, USA; McCauley, D. E., Compiler, Alabama Univ., USA; NASA Microgravity Materials Science Conference; February 1999; 742p; In English; 3rd; Microgravity Materials Science, 14-16 Jul. 1998, Huntsville, AL, USA; Sponsored by NASA, USA; See also 19990040242 through 19990040364

Contract(s)/Grant(s): NCC8-66

Report No.(s): NASA/CP-1999-209092; M-911; NAS 1.55:209092; No Copyright; Avail: CASI; A99, Hardcopy; A06, Microfiche

The Microgravity Materials Science Conference was held July 14-16, 1998 at the Von Braun Center in Huntsville, AL. It was organized by the Microgravity Materials Science Discipline Working Group, sponsored by the Microgravity Research Division at NASA Headquarters, and hosted by the NASA Marshall Space Flight Center and the Alliance for Microgravity Materials Science and Applications. It was the third NASA conference of this type in the microgravity materials science discipline. The microgravity science program sponsored approximately 125 investigations and 100 principal investigators in FY98, almost all of whom made oral or poster presentations at this conference. The conference's purpose was to inform the materials science community of research opportunities in reduced gravity in preparation for a NASA Research Announcement scheduled for release in late 1998 by the Microgravity Research Division at NASA Headquarters. The conference was aimed at materials science researchers from academia, industry, and government. A tour of the Marshall Space Flight Center microgravity research facilities was held on July 16, 1998. This volume is comprised of the research reports submitted by the principal investigators after the conference.

Author

Conferences; Spaceborne Experiments; Space Processing; Microgravity; Gravitational Effects; Crystal Growth

19990040242 NASA Lewis Research Center, Cleveland, OH USA

In-Situ Monitoring of a Bismuth-Tin Alloy Solidification Using MEPHISTO

Abbaschian, Reza, Florida Univ., USA; Beatty, Kirk M., Florida Univ., USA; Chen, Fuwang, Florida Univ., USA; deGroh, Henry, III, NASA Lewis Research Center, USA; Cambon, Gerard, Centre National d'Etudes Spatiales, France; NASA Microgravity Materials Science Conference; February 1999, pp. 1-6; In English; See also 19990040241; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

Experiments were carried out to study the morphological stability of Bi- 1 atomic % Sn alloys using the MEPHISTO directional solidification apparatus aboard Space Shuttle Columbia (STS-87, launched Nov. 19, 1997) and in ground-based studies. The Seebeck signal and temperature measurements indicate that convection was significant for ground-based studies. In the space-based experiments, interface breakdown was observed at growth velocities of 6.7, 27, and 40 microns/sec, but not at 1.8 and 3.3 microns/sec.

Author

Spaceborne Experiments; Space Processing; Gravitational Effects; Directional Solidification (Crystals); Seebeck Effect; Liquid-Solid Interfaces; Crystal Growth; Interface Stability; Bismuth Alloys; Tin Alloys

19990040243 National Center for Microgravity Research on Fluids and Combusiton, Cleveland, OH USA

Study of Interesting Solidification Phenomena on the Ground and in Space (MEPHISTO)

Alexander, J. Iwan D., National Center for Microgravity Research on Fluids and Combusiton, USA; Favier, J.-J., Commissariat a l'Energie Atomique, France; Garandet, J.-P., Commissariat a l'Energie Atomique, France; NASA Microgravity Materials Science Conference; February 1999, pp. 7-12; In English; See also 19990040241

Contract(s)/Grant(s): NAG3-1740; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

Real-time Seebeck voltage variations in a Sn-Bi melt during directional solidification in the MEPHISTO spaceflight experiment flown on the USMP-3 mission, have been correlated with well-characterized thruster firings and an Orbiter Main System (OMS) burn. The Seebeck voltage measurement is related to the response of the instantaneous average melt composition at the melt-crystal interface. This allowed us to make a direct comparison of numerical simulations with the experimentally obtained Seebeck signals. Based on the results of preflight and real-time computations, several well-defined thruster firing events were programmed to occur at specific times during the experiment. In particular, we simulated the effects of the thruster firings on melt and crystal composition in a directionally solidifying Sn-Bi alloy. The relative accelerations produced by the firings were simulated by impulsive accelerations of the same magnitude, duration and orientation as the requested firings. A comparison of the simulation results with the Seebeck signal indicates that there is a good agreement between the two. This unique opportunity allows us to make the first quantitative characterization of actual g-jitter effects on an actual crystal growth experiment and to calibrate our models of g-jitter effects on crystal growth.

Author

Spaceborne Experiments; Space Processing; Crystal Growth; Directional Solidification (Crystals); Melts (Crystal Growth); Seebeck Effect; Computerized Simulation; Acceleration (Physics); Vibration Effects

19990040244 Oklahoma Univ., School of Aerospace and Mechanical Engineering, Norman, OK USA

Microgravity Impregnation of Fiber Preforms

Altan, M. Cengiz, Oklahoma Univ., USA; NASA Microgravity Materials Science Conference; February 1999, pp. 13-18; In English; See also 19990040241; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

It is well known that the spreading of liquids and wetting of solid surfaces in space exhibit a number of significant fluid management challenges as well as numerous interesting phenomena. Many of these phenomena are also technologically important in fabricating high-performance parts in space such as the structural components needed to build the space station or medium to large panels needed for repair in space. The ability to manufacture geometrically complex, lightweight and high performance composite parts in space primarily depends on understanding and subsequent controlling of flow processes such as filling a mold cavity, spreading or coating a solid surface, and impregnation of a porous fiber preform. For example, most high-performance molding operations involve impregnation of a fibrous preform where the balance between viscous and surface forces as well as nonisothermal effects significantly affect the fluid behavior. It is believed that microgravity provides the necessary means to mold much stronger/stiffer composite materials due to achieving higher volume content of the reinforcing preform. In addition, the complete process can be accomplished with much simpler, lighter, and inexpensive tooling and molding equipment. The objective of the current research is to contribute to the understanding of microgravity impregnation and wetting of porous media, and to develop low-pressure molding methodologies to fabricate high-performance composite materials. Investigating the effects of capillary forces and gravity on mold filling will be among the primary objectives. The flow through porous media induced during the filling of a centergated mold cavity will be studied under 1-g and microgravity conditions. The proposed experiments aim at understanding the effects of fluid viscosity, external pressure (i.e., impregnation pressure), surface tension, and microstructure of the wetted porous media on the flow kinematics.

Derived from text

Spaceborne Experiments; Gravitational Effects; Space Manufacturing; Impregnating; Preforms; Composite Materials; Molding Materials; Spreading; Wetting

19990040246 Alabama Univ., Dept. of Materials and Mechanical Engineering, Birmingham, AL USA

Coupled Growth in Hypermonotectics (Primary Experiment) and Wetting Characteristics of Immiscibles (Glovebox Investigation)

Andrews, Barry, Alabama Univ., USA; Coriell, Sam, National Inst. of Standards and Technology, USA; NASA Microgravity Materials Science Conference; February 1999, pp. 25-32; In English; See also 19990040241; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

The objective of this continuing investigation is to gain an improved understanding of solidification processes in immiscible alloy systems. A portion of the Coupled Growth in Hypermonotectics (CGH) study involves the development of experimental techniques which will permit solidification of immiscible alloys to produce aligned microstructures. A parallel effort is underway

to develop a model for the solidification process in these alloy systems. Results from experimentation will be compared to those predicted from the model and utilized to improve the model. In order to permit solidification under the conditions necessary to form fibrous structures in these immiscible alloys, experimentation must be carried out under low-gravity conditions. The first phase of the CGH experiment flew aboard the Life and Microgravity Spacelab (LMS) mission during the summer of 1996. Processing conditions were controlled in an attempt to force the production of an aligned fibrous phase in the microstructure of processed samples. This capacity could prove important in some of the proposed applications of immiscible alloys which include use as superconductors and as high performance magnetic materials. The Advanced Gradient Heating Facility (AGHF) was used to directionally solidify the immiscible alloys. Alloys in the aluminum indium system were studied and specialized aluminum nitride ampoules were used in order to control several undesirable effects that are sometimes observed during low gravity processing. to summarize our findings to date, three immiscible aluminum indium samples were directionally solidified during the LMS mission. Two of these samples contained voids that were sufficient in size to modify the solidification parameters locally during processing. In addition, the aluminum-indium alloy leaked past the uppermost piston in two of the flight ampoules and one of the ground based ampoules and destroyed the carbon spring. Most work to date has concentrated on identifying the gas present in the voids in order to help determine their source. Residual gas analysis revealed that the voids contained primarily nitrogen with some 30 ampoules also containing smaller amounts of another gas, which, at this stage is thought to be carbon monoxide. Additional testing is being carried out to verify this finding. Twelve samples in the transparent model system, succinonitrile-glycerin, were processed during the USMP-4 mission in the fall of 1997. A transparent cell assembly was utilized to permit direct observation of the events taking place. Sample compositions covered the majority of the composition range of the miscibility gap. A small composition range was identified in which the cell gasket surface was perfectly wet by the minor liquid phase. This perfect wetting led to the formation of a film of the minor phase along the perimeter of the cell. This behavior may explain difficulties encountered by some investigators in producing a uniform dispersion in microgravity processed immiscible alloy systems. An unexplained observation was made at one of the composition extremes where droplets were found to move away from the gasket surface leaving a depleted region during processing. Further analysis of the data is underway.
Derived from text
Spaceborne Experiments; Space Processing; Gravitational Effects; Monotectic Alloys; Wetting; Solubility; Directional Solidification (Crystals)

19990040247 Alabama Univ., Dept. of Materials and Mechanical Engineering, Birmingham, AL USA
The Effect of Convection on Morphological Stability During Coupled Growth in Immiscible Systems
Andrews, Barry, Alabama Univ., USA; Coriell, Sam, National Inst. of Standards and Technology, USA; NASA Microgravity Materials Science Conference; February 1999, pp. 33-38; In English; See also 19990040241; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

The objective of this study to determine the influence of convection on the morphological stability of the solid-liquid interface during directional solidification in immiscible systems. Recent findings indicate that gravity level has a dramatic influence on the structure obtained during directional solidification in these systems. Evidence from ground based experimentation by the investigators indicates this variation in microstructure may be due to fluid flow which occurs on both a microscopic scale at the solid-liquid interface and on a macroscopic scale during the solidification process. The overall fluid flow generated appears to reduce the stability of the solidification front during coupled growth influencing the development of desired fibrous microstructures. This study combines observations made utilizing transparent metal-analog systems with a detailed analysis of fluid flow on a microscopic and macroscopic scale. One segment involves a theoretical analysis to determine the anticipated fluid flow at the solidification front. Another segment involves experimentation to either verify or disclose weaknesses in the theoretical portion of the analysis. The findings will make a significant contribution to a better understanding of the role of fluid flow on steady state solidification and coupled growth in immiscible alloys.
Derived from text
Directional Solidification (Crystals); Monotectic Alloys; Gravitational Effects; Liquid-Solid Interfaces; Interface Stability; Microstructure; Fluid Flow; Convection

19990040250 North Carolina State Univ., Dept. of Materials Science and Engineering, Raleigh, NC USA
Chemical Vapor Deposition at High Pressure in a Microgravity Environment
McCall, Sonya, North Carolina State Univ., USA; Bachmann, Klaus, North Carolina State Univ., USA; LeSure, Stacie, North Carolina State Univ., USA; Sukidi, Nkadi, North Carolina State Univ., USA; Wang, Fuchao, North Carolina State Univ., USA; NASA Microgravity Materials Science Conference; February 1999, pp. 51-56; In English; See also 19990040241
Contract(s)/Grant(s): NCC8-95; F49620-95-1-0447; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

In this paper we present an evaluation of critical requirements of organometallic chemical vapor deposition (OMCVD) at elevated pressure for a channel flow reactor in a microgravity environment. The objective of using high pressure is to maintain single-phase surface composition for materials that have high thermal decomposition pressure at their optimum growth temperature. Access to microgravity is needed to maintain conditions of laminar flow, which is essential for process analysis. Based on ground based observations we present an optimized reactor design for OMCVD at high pressure and reduced gravity. Also, we discuss non-intrusive real-time optical monitoring of flow dynamics coupled to homogeneous gas phase reactions, transport and surface processes. While suborbital flights may suffice for studies of initial stages of heteroepitaxy experiments in space are essential for a complete evaluation of steady-state growth.
Author
Microgravity; Gravitational Effects; Metalorganic Chemical Vapor Deposition; Reactor Design; Laminar Flow; Fluid Dynamics

19990040252 Alabama Univ., Center for Microgravity and Materials Research, Huntsville, AL USA
Self-Diffusion in Liquid Elements
Banish, R. Michael, Alabama Univ., USA; Jalbert, Lyle, Alabama Univ., USA; Alexander, J. Iwan. D., Case Western Reserve Univ., USA; NASA Microgravity Materials Science Conference; February 1999, pp. 63-69; In English; See also 19990040241; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

With increasing conceptual insight into transport and segregation in solidification and crystal growth, reliable data for diffusivities in liquid metals and semiconductors have become essential for guidance in process development. However, at this point even self-diffusion in elemental liquids is not well understood, let alone binary diffusion. In particular, there is little insight into the temperature dependence of diffusivities, D(T), and its correlation to the temperature-dependent structure of the liquid. Although various theories for D(T) have been developed over the years, the uncertainties associated with most diffusivity data are too large to allow for an unambiguous evaluation of these theoretical models. Currently, the differences between several theoretical predictions are often less than those between different sets of data for the same system. In addition, most D(T) data are limited to relatively narrow ranges in temperature beyond an element's melting point. Hence, for both theoretical and technological developments, there is a clear need for diffusivity measurements of improved accuracy and precision over wide temperature ranges for a variety of elements. In the planned space experiments, the self-diffusivities of select liquid elements will be measured. A technique will be used that yields diffusivities at several temperatures with one sample. Thus, wide temperature ranges can be covered with a small number of samples. In this approach, which circumvents solidification of the diffusion sample prior to the concentration profiling, the evolution of the concentration distribution of a radiotracer is followed in real time using two pairs of radiation detectors. Furthermore, by employing an isotope which emits photons at (two) sufficiently different energies, transport in the bulk of the sample and near the container wall will be distinguished. The scientific objectives of the proposed space experiments include the: (1) accurate measurement of self-diffusivities over a wide range in temperature in elements selected for their class-like liquid structure properties; (2) interpretation of the measured diffusivities in terms of diffusion mechanisms and associated, temperature-dependent liquid structures; and (3) quantification of the "wall effect" believed by some to contaminate diffusivity measurements in capillaries. In the report we cover selected topics that either were not addressed during the 1996 Microgravity Materials Science Conference, or have been completed following this Conference.
Derived from text
Diffusivity; Liquid Metals; Crystal Growth; Temperature Dependence; Spaceborne Experiments; Space Processing; Microgravity

19990040253 NASA Marshall Space Flight Center, Huntsville, AL USA
Experiments on Nucleation in Different Flow Regimes
Bayuzick, R. J., Vanderbilt Univ., USA; Hofmeister, W. H., Vanderbilt Univ., USA; Morton, C. M., Vanderbilt Univ., USA; Robinson, M. B., NASA Marshall Space Flight Center, USA; NASA Microgravity Materials Science Conference; February 1999, pp. 71-76; In English; See also 19990040241; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

The vast majority of metallic engineering materials are solidified from the liquid phase. Understanding the solidification process is essential to control microstructure, which in turn, determines the properties of materials. The genesis of solidification is nucleation, where the first stable solid forms from the liquid phase. Nucleation kinetics determine the degree of undercooling and phase selection. As such, it is important to understand nucleation phenomena in order to control solidification or glass formation in metals and alloys. Early experiments in nucleation kinetics were accomplished by droplet dispersion methods. Dilatometry was used by Turnbull and others, and more recently differential thermal analysis and differential scanning calorimetry have been used for kinetic studies. These techniques have enjoyed success; however, there are difficulties with these experiments. Since materials are dispersed in a medium, the character of the emulsion/metal interface affects the nucleation behavior. Statistics are derived from the large number of particles observed in a single experiment, but dispersions have a finite size distribution which adds to the

uncertainty of the kinetic determinations. Even though temperature can be controlled quite well before the onset of nucleation, the release of the latent heat of fusion during nucleation of particles complicates the assumption of isothermality during these experiments. Containerless processing has enabled another approach to the study of nucleation kinetics. With levitation techniques it is possible to undercool one sample to nucleation repeatedly in a controlled manner, such that the statistics of the nucleation process can be derived from multiple experiments on a single sample. The authors have fully developed the analysis of nucleation experiments on single samples following the suggestions of Skripov. The advantage of these experiments is that the samples are directly observable. The nucleation temperature can be measured by noncontact optical pyrometry, the mass of the sample is known, and post processing analysis can be conducted on the sample. The disadvantages are that temperature measurement must have exceptionally high precision, and it is not possible to isolate specific heterogeneous sites as in droplet dispersions.
Derived from text
Spaceborne Experiments; Space Processing; Nucleation; Solidification; Containerless Melts; Temperature Measurement; Levitation Melting

19990040254 Vanderbilt Univ., Dept. of Chemical Engineering, Nashville, TN USA
Investigation of the Relationship Between Undercooling and Solidification Velocity
Bassler, B. T., Vanderbilt Univ., USA; Altgilbers, A., Vanderbilt Univ., USA; Hofmeister, W. H., Vanderbilt Univ., USA; Bayuzick, R. J., Vanderbilt Univ., USA; NASA Microgravity Materials Science Conference; February 1999, pp. 77-82; In English; See also 19990040241; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

The overarching driver for this work is the heart of Materials Science, namely the understanding of microstructure and its genesis. For solidification processing, two dominant factors for microstructural development are undercooling and solidification speed but these are not, at this time, nominally fully utilized as parameters. One reason is that the effects of undercooling and solidification velocity on microstructure are not quantitatively understood. Furthermore, the relationships between undercooling and solidification velocity are not completely understood. Two pivotal aspects of the lack of understanding are disagreement between theory and experimental results on ”bulk” samples and the disagreement between experimental results. Thus, the principal objective of this work is to accurately and systematically quantify the solidification velocity as a function of deep undercooling for pure metals and alloys. The primary hypothesis to be tested is that present theories on the effect of undercooling on solidification velocity do not predict the actual behavior. Within this framework and the framework of flight definition, another objective is to pinpoint the adequacy of ground based experimentation and, conversely, the need for microgravity experimentation. The general approach is to use direct imaging at high frame rates (up to 1,000,000 frames per second) to measure the speed of solidification at high undercoolings. Electromagnetic and electrostatic levitation techniques are to be used to limit heterogeneous nucleation and to obtain an unobstructed direct view. Pure nickel, pure titanium, pure silicon, nickel based alloys and titanium based alloys are the materials of interest.
Derived from text
Levitation Melting; Solidification; Supercooling; Imaging Techniques; Microstructure

19990040263 Michigan Technological Univ., Dept. of Metallurgical and Materials Engineering, Houghton, MI USA
Gravity Induced Settling in Interconnected Liquid-Solid Systems: Simulation
Courtney, T. H., Michigan Technological Univ., USA; Spencer, J. A., Michigan Technological Univ., USA; Lu, S. Z., Michigan Technological Univ., USA; NASA Microgravity Materials Science Conference; February 1999, pp. 127-132; In English; See also 19990040241; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

We have presented preliminary results on numerical mimicking of settling in solid-liquid interconnected systems. Such modeling can be couched in terms of an effective time constant for settling. The settling rate relates directly to this constant and, when the constant does not depend on solid phase volume fraction, the solid phase concentration is - excepting for regions near the sample ends - uniform along the sample length. When the settling time constant increases with V(sub P), this variation is not as uniform. Modeling results will be used in conjunction with experimental studies in an attempt to determine the mechanism of solid phase sedimentation in solid-liquid interconnected structures. This will be done by reconciliation of experimental results with numerical simulations of the type described here.
Derived from text
Liquid-Solid Interfaces; Mixtures; Settling; Mathematical Models; Concentration (Composition)

19990040265 NASA Marshall Space Flight Center, Huntsville, AL USA
Fundamental Studies of Solidification in Microgravity Using Real-Time X-Ray Microscopy
Curreri, Peter A., NASA Marshall Space Flight Center, USA; Kaukler, William, Alabama Univ., USA; Sen, Subhayu, Universities Space Research Association, USA; Bhat, Biliyar N., NASA Marshall Space Flight Center, USA; NASA Microgravity Materials

Science Conference; February 1999, pp. 139-146; In English; See also 19990040241; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

This research applies a state of the art X-ray Transmission Microscope, XTM, to image (with resolutions up to 3 micrometers) the solidification of metallic or semiconductor alloys in real-time. We have successfully imaged in real-time: interfacial morphologies, phase growth, coalescence, incorporation of phases into the growing interface, and the solute boundary layer in the liquid at the solid-liquid interface. We have also measured true local growth rates and can evaluate segregation structures in the solid; a form of in-situ metallography. During this study, the growth of secondary phase fibers and lamellae from eutectic and monotectic alloys have been imaged during solidification, in real-time, for the first time in bulk metal alloys. Current high resolution X-ray sources and high contrast X-ray detectors have advanced to allow systematic study of solidification dynamics and the resulting microstructure. We have employed a state-of-the-art sub-micron source with acceleration voltages of 10-100 kV to image solidification of metals. One useful strength of the XTM stems from the manner an image is formed. The radiographic image is a shadow formed by x-ray photons that are not absorbed as they pass through the specimen. Composition gradients within the specimen cause variations in absorption of the flux such that the final image represents a spatial integral of composition (or thickness). The ability to image these features in real-time enables more fundamental and detailed understanding of solidification dynamics than has previously been possible. Hence, application of this technique towards microgravity experiments will allow rigorous testing of critical solidification models.

Author

Solidification; Monotectic Alloys; Microscopy; X Ray Analysis; Liquid-Solid Interfaces; Eutectic Alloys; Imaging Techniques; Metallography; Melts (Crystal Growth); Microstructure

19990040272 Ohio State Univ., Dept. of Chemistry, Columbus, OH USA

Reverse Micelle-Based Synthesis of Microporous Materials in Microgravity

Dutta, Prabir K., Ohio State Univ., USA; NASA Microgravity Materials Science Conference; February 1999, pp. 175-180; In English; See also 19990040241; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

Microporous materials are crystalline frameworks with well defined cages and channels of molecular dimensions varying from 2 to 8 Angstroms. Various elements such as silicon, aluminum, zinc, phosphorus, gallium and transition metals can form the backbone of the framework. These elements, abbreviated as T and T' make up the framework through T-O-T' linkages. The most commonly used microporous frameworks are aluminosilicate zeolites. These find extensive use in detergents and catalysts. The ion-exchange of the extraframework ions are exploited in detergent use. The catalytic behavior arises because super-acidity can be introduced into these frameworks and the topography of the channels and cages influence product formation. Discovery of novel frameworks can have significant impact on practical applications, as in the recent introduction by Unilever of a new zeolite in detergents and the use of ZSM-5 in petroleum cracking. Thus, there is considerable effort worldwide in the synthesis of new frameworks. Microporous materials are typically made under hydrothermal conditions. Influence of the nature of starting reactants, structure directing agents, pH, temperature, aging -- all have profound influence on microporous material crystallization. This is primarily because the most interesting open frameworks are not stable structures in the synthesis medium. Thus, the discovery of new structures is often tied to finding the right reaction conditions that allow for kinetic stabilization of the structure. Because of the complexity of the synthesis process, most advances in microporous materials synthesis are made by trial and error. There has been a concerted effort over the past few decades to gain a comprehensive understanding of the crystal growth process, which would result in more directed synthesis of these materials. The important issues in crystal growth are: molecular structure and assembly of the nuclei; nature of the nucleation process; growth of nuclei into crystals; factors influencing morphology; and transformation of frameworks into subsequent structures. The NASA-funded research described here is involved in exploring all the above issues of microporous materials nucleation and crystal growth. Our synthetic approach is significantly different from conventional synthesis because our focus has been to design methods that will be eventually tested in microgravity. We summarize below our recent results. Experimental aspects of our research can be found in several publications.

Derived from text

Microgravity; Microporosity; Crystal Growth; Detergents; Nucleation; Molecular Structure; Morphology; Crystallization

19990040273 Virginia Commonwealth Univ., Dept. of Chemistry, Richmond, VA USA

Synthesis of Semiconductor and Metal Oxide Nanoparticles by Laser Vaporization-Controlled Condensation Techniques

El-Shall, M. Samy, Virginia Commonwealth Univ., USA; NASA Microgravity Materials Science Conference; February 1999, pp. 181-186; In English; See also 19990040241; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

Nanoparticles often exhibit novel properties, which are different from the bulk materials' properties. Many of these properties show strong dependence on size, shape and surface preparation. The characterization of these properties can ultimately lead to identifying many potential uses, particularly in the field of catalysis. Research in this area is motivated by the possibility of design-

ing nanostructured materials that possess novel electronic, optical, magnetic, photochemical and catalytic properties. Such materials are essential for technological advances in photonics, quantum electronics, nonlinear optics and information storage and processing. The primary objective of this work is to develop a novel technique to synthesize nanoparticles of controlled size and composition. Our technique combines the advantages of pulsed laser vaporization with controlled condensation (LVCC) in a diffusion cloud chamber under well-defined conditions of temperature and pressure. It allows the synthesis of a wide variety of nanoparticles of metal oxides, carbides and nitrides. Furthermore, the same method can be coupled to plasma and ionic polymerization techniques, thus allowing the incorporation of the metallic nanoparticles within the polymer films. The application of this method under a microgravity environment is expected to allow better control of the microstructure and morphology of these particles since size-induced segregation effects will be dramatically reduced relative to ambient conditions. It should be possible to grow clusters of well-defined sizes and make layered structures of controlled compositions. The use of laser vaporization will make it possible to vaporize several different metals either simultaneously or sequentially and deposit multilayers of engineered compositions and particle size distributions. The characterization of the surface-oxidized Si nanocrystals and their photoluminescence (PL) properties will be discussed here. One of the main goals of this work is to compare the results of the PL from the solid surface-oxidized particles that were previously studied, with those from the incorporated particles in polymer films. We also study the properties of the photochromic nanoparticles of molybdenum and tungsten trioxides prepared by the LVCC method.
Derived from text
Nanocrystals; Semiconductors (Materials); Metal Oxides; Photoluminescence; Photochromism

19990040279 Massachusetts Inst. of Tech., Dept. of Materials Science and Engineering, CamBridge, MA USA
The Measurement of the Viscosity and Surface Tension of Undercooled Melts Under Microgravity Conditions and Supporting MHD Calculations
Hyers, Robert, Massachusetts Inst. of Tech., USA; Trapaga, Gerardo, Massachusetts Inst. of Tech., USA; Flemings, Merton C., Massachusetts Inst. of Tech., USA; NASA Microgravity Materials Science Conference; February 1999, pp. 219-224; In English; See also 19990040241; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

Experiments carried out during the STS83 and STS94 mission provided successful containerless viscosity measurements using EML for a wide range of temperatures and viscosities. Also resulted precise, containerless measurement of surface tension and its temperature dependence over a wide temperature range. Analysis of surface tension data indicated that Cummings and Blackburn's correction, while only 1-3% for these microgravity experiments, is still important. The theoretical analysis, based on the use of mathematical modeling techniques, proved to be very useful to provide important information for the design and analysis of EML experiments. As illustrated in this report, the modeling work allowed to obtain some important insight into the role of internal flows on the behavior of the droplet for different samples and type of experiments, for example by providing a sound explanation of the occurrence of dynamic nucleation in nucleation experiments for Zr.
Derived from text
Spaceborne Experiments; Space Processing; Microgravity; Gravitational Effects; Nucleation; Viscosity; Magnetohydrodynamics; Supercooling; Interfacial Tension

19990040281 NASA Langley Research Center, Hampton, VA USA
Growth of Compound Semiconductors in a Low Gravity Environment: Microgravity Growth of PbSnTe
Fripp, Archibald L., NASA Langley Research Center, USA; Debnam, William J., NASA Langley Research Center, USA; Rosch, William R., National Academy of Sciences - National Research Council, USA; Baker, N. R., Lockheed Martin Engineering and Sciences Co., USA; Narayanan, R., Florida Univ., USA; NASA Microgravity Materials Science Conference; February 1999, pp. 229-234; In English; See also 19990040241; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

The growth of the alloy compound semiconductor lead tin telluride (PbSnTe) was chosen for a microgravity flight experiment in the Advanced Automated Directional Solidification Furnace (AADSF), on the USA Microgravity Payload-3 (USMP-3) and on USMP-4 Space Shuttle flights in February, 1996, and November, 1997. The objective of these experiments was to determine the effect of the reduction in convection, during the growth process, brought about by the microgravity environment. The properties of devices made from PbSnTe are dependent on the ratio of the elemental components in the starting crystal. Compositional uniformity in the crystal is only obtained if there is no significant mixing in the liquid during growth. Lead tin telluride is an alloy of PbTe and SnTe. The technological importance of PbSnTe lies in its band gap versus composition diagram which has a zero energy crossing at approximately 40% SnTe. This facilitates the construction of long wavelength (>6 micron) infrared detectors and lasers. Observations and experimental methods of crystal growth of PbSnTe on both Space Shuttle Flights are presented.
Derived from text
Spaceborne Experiments; Space Processing; Microgravity; Gravitational Effects; Lead Tellurides; Convection; Semiconductors (Materials); Crystal Growth; Directional Solidification (Crystals); Crystals

19990040282 NASA Langley Research Center, Hampton, VA USA

Melt Stabilization of PbSnTe in a Magnetic Field

Fripp, Archibald L., NASA Langley Research Center, USA; Debnam, William J., NASA Langley Research Center, USA; Rosch, William, National Academy of Sciences - National Research Council, USA; Chait, Arnon, NASA Lewis Research Center, USA; Yao, Minwu, Ohio Aerospace Inst., USA; Szofran, Frank R., NASA Marshall Space Flight Center, USA; NASA Microgravity Materials Science Conference; February 1999, pp. 235-240; In English; See also 19990040241; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

Both the experimental observation and numerical simulation indicate that the Bridgman growth of PbSnTe under the microgravity environment in space is still greatly influenced by buoyancy-induced convection. The application of a magnetic field during the semiconductor growth can dampen the convective flow in the metal-like melt. However, for Bridgman growth of PbSnTe on earth (with either vertical or horizontal configuration), both experimental observation and numerical modeling suggest that even with a strong magnetic furnace (5-Tesla constant axial magnetic field), the convective flow in the melt still cannot be sufficiently suppressed to reach the diffusion-controlled level. In order to completely dampen the buoyancy-induced convection on earth, estimates based on scaling analysis indicate that for common experimental conditions, an extremely high magnetic field is required, far beyond the capacity of the experimental apparatus currently available. Therefore, it is proposed that only the combination of microgravity environment and magnetic damping will produce the desired diffusion-controlled growth state for this particular material. The primary objectives of this study are to provide a quantitative understanding of the complex transport phenomena during solidification of non-dilute binarys, to furnish a numerical tool for furnace design and growth condition optimization, to provide estimates of the required magnetic field strength for low gravity growth, and to assess the role of magnetic damping for space and earth control of the double-diffusive convection. As an integral part of a NASA research program, our numerical simulation supports both the flight and ground-based experiments in an effort to bring together a complete picture of the complex physical phenomena involved in the crystal growth process. For Bridgman growth of PbSnTe under microgravity (with both vertical and horizontal configurations), the simulations suggest that a moderate axial magnetic field of only a few kilo-Gauss in strength could effectively eliminate buoyancy-induced convection in the melt and control solute segregation. Therefore, this work confirms the idea that the combination of microgravity environment and the magnetic damping will indeed be sufficient to produce the desired diffusion-controlled growth state for PbSnTe.

Derived from text

Microgravity; Gravitational Effects; Bridgman Method; Buoyancy; Convection; Crystal Growth; Magnetic Fields; Lead Tellurides; Magnetohydrodynamics; Navier-Stokes Equation; Finite Element Method

19990040283 Pennsylvania State Univ., P/M Lab., University Park, PA USA

Gravitational Role in Liquid Phase Sintering

German, Randall M., Pennsylvania State Univ., USA; Iacocca, Ronald G., Pennsylvania State Univ., USA; NASA Microgravity Materials Science Conference; February 1999, pp. 241-246; In English; See also 19990040241; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

Liquid phase sintering (LPS) is a common process for the fabrication of dense, net-shape structures. Despite extensive industrial use, several processing difficulties trace to gravity. One easily recognized problem is solid-liquid separation. Like sand settling in water, differences in densities between the solid and liquid phases induce microstructure and compositional segregation. Consequently, only alloys with small quantities of liquid are fabricated on Earth. The tungsten heavy alloys (W-Ni-Fe or W-Ni-Cu) are particularly sensitive to gravitational effects since the liquid-solid density difference is nearly 9 g/cu cm. In this research, we have documented that after sintering on Earth there is a significant gradient in grain coordination number, grain size, grain shape, and solid phase contiguity with the position in the compact. Further, there is a slight difference in grain size due to the compressive stresses during Earth-based sintering. Grain coalescence occurs at gravity induced contacts, giving gradients from the stress in the microstructure due to gravity. It was on the basis of these observations that microgravity and parallel ground-based experiments were performed. A universal grain size distribution for LPS materials has been isolated and described mathematically, and this distribution agrees with recent independent findings. The volume fraction of liquid has been mathematically linked to the grain growth rate constant and solid-liquid density difference for LPS materials, giving the first universal coarsening law applicable to the solid contents characteristic of LPS. A model has been created for slumping and distortion during LPS. This model describes the role of gravity, component size, substrate friction, and surface tension on reshaping processes. Analysis has shown an important role of grain connectivity and dihedral angle on shape preservation during LPS. Evidence exists that grain boundary wetting by newly formed liquid is a key factor in distortion. Grain agglomeration has been predicted and observed in dilute solid content systems. The weak agglomeration force was first modeled for LPS, but may be applicable to many situations including solid-liquid, liquid-liquid, solid-vapor, and liquid-vapor systems. The agglomeration event was observed in microgravity samples sintered by Kohara and Ekbom. Based on pore stabilities in the microgravity samples, we have revisited the derivation of Young's

equation and found Gibbs' original treatment is incorrect since a gravity term was dropped from the derivation. Coalescence has been documented in a zero dihedral angle LPS system conclusively to prove Ostwald ripening theories are incorrect in ignoring this effect. Further, grain rotation as part of coalescence has been measured during long time LPS. Electron channeling experiments will show the emergence of preferred grain orientations for coalescence during long term LPS. Early evidence shows a nonrandom radial distribution function in the grain size of LPS heavy alloys. The settled region of Earth-based LPS samples has been analyzed for the density difference effect and the terminal skeletal structure for no solid-liquid density difference. A model for the solid content versus position in the settled solid structure accurately explains all previous observations. A new generalized idea of grain coordination number versus effective pressure has emerged that may have applicability to loosely packed particles. The model expresses the mean coordination number as a fraction of the effective pressure. Ground-based experiments are being performed to test this model. Pore structure observations in microgravity LPS samples show a high stability. This suggests buoyancy may be important to densification during LPS on Earth. A complication is the lack of a reducing atmosphere during microgravity sintering, but under identical ground-based LIF experiments a gravity role is evident.
Derived from text
Microgravity; Gravitational Effects; Liquid Phase Sintering; Grain Size; Ostwald Ripening

19990040284 NASA Marshall Space Flight Center, Huntsville, AL USA
Solidification of II-VI Compounds in a Rotating Magnetic Field
Gillies, D. C., NASA Marshall Space Flight Center, USA; Volz, M. P., NASA Marshall Space Flight Center, USA; Mazuruk, K., NASA Marshall Space Flight Center, USA; Motakef, S., Cape Simulations, Inc., USA; Dudley, M., State Univ. of New York, USA; Matyi, R., Wisconsin Univ., USA; NASA Microgravity Materials Science Conference; February 1999, pp. 247-252; In English; See also 19990040241; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

This project is aimed at using a rotating magnetic field (RMF) to control fluid flow and transport during directional solidification of elemental and compound melts. Microgravity experiments have demonstrated that small amounts of residual acceleration of less than a micro-g can initiate and prolong fluid flow, particularly when there is a static component of the field perpendicular to the liquid solid interface. Thus a true diffusion boundary layer is not formed, and it becomes difficult to verify theories of solidification or to achieve diffusion controlled solidification. The RMF superimposes a stirring effect on an electrically conducting liquid, and with appropriate field strengths and frequencies, controlled transport of material through a liquid column can be obtained. As diffusion conditions are precluded and complete mixing conditions prevail, the technique is appropriate for traveling solvent zone or float zone growth methods in which the overall composition of the liquid can be maintained throughout the growth experiment. Crystals grown by RMF techniques in microgravity in previous, unrelated missions have shown exceptional properties. The objective of the project is two-fold, namely (1) using numerical modeling to simulate the behavior of a solvent zone with applied thermal boundary conditions and demonstrate the effects of decreasing gravity levels, or an increasing applied RMF, or both, and (2) to grow elements and II-VI compounds from traveling solvent zones both with and without applied RMFs, and to determine objectively how well the modeling predicts solidification parameters. Numerical modeling has demonstrated that, in the growth of CdTe from a tellurium solution, a rotating magnetic field can advantageously modify the shape of the liquid solid interface such that the interface is convex as seen from the liquid. Under such circumstances, the defect structure is reduced as any defects which are formed tend to grow out and not propagate. The flow of liquid, however, is complex due to the competing flow induced by the rotating magnetic field and the buoyancy driven convection. When the acceleration forces are reduced to one thousandth of gravity, the flow pattern is much simplified and well controlled material transport through the solvent zone can be readily achieved. Triple axis diffractometry and x-ray synchrotron topography have demonstrated that there is no significant improvement in crystal quality for HgCdTe grown on earth from a tellurium solution when a rotating magnetic field is applied. However, modeling shows that the flow in microgravity with a rotating magnetic field would produce a superior product.
Derived from text
Microgravity; Gravitational Effects; Cadmium Tellurides; Crystal Growth; Magnetic Fields; Rotation

19990040285 NASA Lewis Research Center, Cleveland, OH USA
The Isothermal Dendritic Growth Experiment (IDGE)
Glicksman, Martin E., Rensselaer Polytechnic Inst., USA; Koss, M. B., Rensselaer Polytechnic Inst., USA; Lupulescu, A. O., Rensselaer Polytechnic Inst., USA; LaCombe, J. C., Rensselaer Polytechnic Inst., USA; Frei, J. E., Rensselaer Polytechnic Inst., USA; Malarik, D. C., NASA Lewis Research Center, USA; NASA Microgravity Materials Science Conference; February 1999, pp. 253-260; In English; See also 19990040241; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

The Isothermal Dendritic Growth Experiment (IDGE) constituted a series of three NASA-supported microgravity experiments, all of which flew aboard the space shuttle, Columbia. This experimental space flight series was designed and operated to grow and record dendrite solidification in the absence of gravity-induced convective heat transfer, and thereby produce a wealth

of benchmark-quality data for testing solidification scaling laws. The data and analysis performed on the dendritic growth speed and tip size in Succinontrie (SCN) demonstrates that although the theory yields predictions that are reasonably in agreement with experiment, there are significant discrepancies. However, some of these discrepancies can be explained by accurately describing the diffusion of heat. The key finding involves recognition that the actual three-dimensional shape of dendrites includes time-dependent side-branching and a tip region that is not a paraboloid of revolution. Thus, the role of heat transfer in dendritic growth is validated, with the caveat that a more realistic model of the dendrite then a paraboloid is needed to account for heat flow in an experimentally observed dendrite. We are currently conducting additional analysis to further confirm and demonstrate these conclusions. The data and analyses for the growth selection physics remain much less definitive. From the first flight, the data indicated that the selection parameter, sigma*, is not exactly a constant, but exhibits a slight dependence on the supercooling. Additional data from the second flight are being examined to investigate the selection of a unique dendrite speed, tip size and shape. The IDGE flight series is now complete. We are currently completing analyses and moving towards final data archiving. It is gratifying to see that the IDGE published results and archived data sets are being used actively by other scientists and engineers. In addition, we are also pleased to report that the techniques and IDGE hardware system that the authors developed with NASA, are being currently employed on both designated flight experiments, like EDSE, and on flight definition experiments, like TDSE.

Derived from text

Spaceborne Experiments; Space Processing; Microgravity; Gravitational Effects; Crystal Growth; Dendritic Crystals

19990040286 NASA Marshall Space Flight Center, Huntsville, AL USA

Evolution of Local Microstructures (ELMS): Spatial Instabilities of Coarsening

Glicksman, Martin E., Rensselaer Polytechnic Inst., USA; Frazier, Donald O., NASA Marshall Space Flight Center, USA; Rogers, Jan R., NASA Marshall Space Flight Center, USA; Witherow, William K., NASA Marshall Space Flight Center, USA; Downey, J. Patton, NASA Marshall Space Flight Center, USA; Facemire, Barbara R., NASA Marshall Space Flight Center, USA; NASA Microgravity Materials Science Conference; February 1999, pp. 261-270; In English; See also 19990040241; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

This work examines the diffusional growth of discrete phase particles dispersed within a matrix. Engineering materials are microstructurally heterogeneous, and the details of the microstructure determine how well that material performs in a given application. Critical to the development of designing multiphase microstructures with long-term stability is the process of Ostwald ripening. Ripening, or phase coarsening, is a diffusion-limited process which arises in polydisperse multiphase materials. Growth and dissolution occur because fluxes of solute, driven by chemical potential gradients at the interfaces of the dispersed phase material, depend on particle size. The kinetics of these processes are ”competitive,” dictating that larger particles grow at the expense of smaller ones, overall leading to an increase of the average particle size. The classical treatment of phase coarsening was done by Todes, Lifshitz, and Slyozov, (TLS) in the limit of zero volume fraction, V(sub v), of the dispersed phase. Since the publication of TLS theory there have been numerous investigations, many of which sought to describe the kinetic scaling behavior over a range of volume fractions. Some studies in the literature report that the relative increase in coarsening rate at low (but not zero) volume fractions compared to that / 2 1/ 3 predicted by TLS is proportional to V(sub v)(exp 1/2), whereas others suggest V(sub v)(exp 1/3). This issue has been resolved recently by simulation studies at low volume fractions in three dimensions by members of the Rensselaer/MSFC team.

Derived from text

Microstructure; Ostwald Ripening; Phase Transformations; Crystallization; Mathematical Models; Coarseness; Laplace Equation; Experiment Design; Spaceborne Experiments

19990040287 Georgia Inst. of Tech., School of Materials Science and Engineering, Atlanta, GA USA

Effect of Gravity on Microstructural Evolution During Liquid Phase Sintering: A Quantitative Approach

Gokhale, Arun M., Georgia Inst. of Tech., USA; Tewari, Asim, Georgia Inst. of Tech., USA; Mirabelli, Tom, Georgia Inst. of Tech., USA; NASA Microgravity Materials Science Conference; February 1999, pp. 271-276; In English; See also 19990040241; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

Serial sectioning and image processing techniques are established to recreate large volume high-resolution three-dimensional microstructure of tungsten heavy alloys. Combination of serial sections, reconstructed three-dimensional microstructure and stereological methods permit unbiased and assumption-free estimation of the following parameters: (1) Average volume of W grains; (2) Variance of grain volume distribution; and (3) Number density of necks and grains. The variance of grain volume distribution is smaller in micro-gravity processed specimens, which implies a narrower grain volume distribution. There is a significant difference in the evolution of grain volume distribution in the specimens processed in normal gravity and micro-gravity. The data reveal that kinetics of Liquid Phase Sintering (LPS) process are slower in micro-gravity. The 3D microstructural reconstruc-

tion and connectivity data suggest that these LPS microstructures consist of linear chains of connected grains having branches and nodes.
Derived from text
Gravitational Effects; Microgravity; Microstructure; Liquid Phase Sintering; Grain Size

19990040289 Universities Space Research Association, Huntsville, AL USA
Utilizing Controlled Vibrations in a Microgravity Environment to Understand and Promote Microstructural Homogeneity During Floating-Zone Crystal Growth
Grugel, Richard N., Universities Space Research Association, USA; NASA Microgravity Materials Science Conference; February 1999, pp. 283-288; In English; See also 19990040241
Contract(s)/Grant(s): NAG8-1230; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

It has been demonstrated in floating-zone configurations utilizing silicone oil and nitrate salts that mechanically induced vibration effectively minimizes detrimental, gravity independent, thermocapillary flow. The processing parameters leading to crystal improvement and aspects of the on-going modeling effort are discussed. Plans for applying the crystal growth technique to commercially relevant materials, e.g., silicon, as well as the value of processing in a microgravity environment are presented.
Author
Microgravity; Gravitational Effects; Microstructure; Vibration; Crystal Growth; Capillary Flow; Crystallization; Float Zones

19990040290 Universities Space Research Association, Huntsville, AL USA
Novel Directional Solidification Processing of Hypermonotectic Alloys
Grugel, Richard N., Universities Space Research Association, USA; NASA Microgravity Materials Science Conference; February 1999, pp. 289-294; In English; See also 19990040241
Contract(s)/Grant(s): NCC8-1231; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

Gravity driven separation precludes uniform microstructural development during controlled directional solidification (DS) processing of hypermonotectic alloys. It is well established that liquid/liquid suspensions, in which the respective components are immiscible and have significant density differences, can be established and maintained by utilizing ultrasound. A historical introduction to this work is presented with the intent of establishing the basis for applying the phenomena to promote microstructural uniformity during controlled directional solidification processing of immiscible mixtures. Experimental work based on transparent organics, as well as salt systems, will be presented in view of the processing parameters.
Author
Directional Solidification (Crystals); Microstructure; Gravitation; Monotectic Alloys; Microgravity; Ultrasonic Processing

19990040291 Ohio State Univ., Dept. of Materials Science and Engineering, Columbus, OH USA
Inter-Diffusion in the Presence of Free Convection
Gupta, Prabhat K., Ohio State Univ., USA; NASA Microgravity Materials Science Conference; February 1999, pp. 295-300; In English; See also 19990040241
Contract(s)/Grant(s): NAG8-1470; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

Because of their technological importance, establishment of the precise values of interdiffusion coefficients is important in multicomponent fluid systems. Such values are not available because diffusion is influenced by free convection due to compositionally induced density variations. In this project, earth based diffusion experiments are being performed in a viscous fluid system PbO-SiO2 at temperatures between 500-1000 C. This system is chosen because it shows a large variation in density with small changes in composition and is expected to show a large free convection effect. Infinite diffusion couples at different temperatures and times are being studied with different orientations with respect to gravity. Composition fields will be measured using an Electron Microprobe Analyzer and will be compared with the results of a complementary modeling study to extract the values of the true diffusion coefficient from the measured diffusion profiles.
Author
Microgravity; Gravitational Effects; Diffusion; Free Convection; Viscous Fluids; Diffusion Coefficient; Melts (Crystal Growth); Crystal Growth

19990040294 NASA Marshall Space Flight Center, Huntsville, AL USA
Microgravity Processing of Oxide Superconductors
Olive, James R., Vanderbilt Univ., USA; Hofmeister, William H., Vanderbilt Univ., USA; Bayuzick, Robert J., Vanderbilt Univ., USA; Vlasse, Marcus, NASA Marshall Space Flight Center, USA; NASA Microgravity Materials Science Conference; February 1999, pp. 313-318; In English; See also 19990040241; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

Considerable effort has been concentrated on the synthesis and characterization of high T(sub c) oxide superconducting materials. The YBaCuO system has received the most intense study, as this material has shown promise for the application of both thin film and bulk materials. There are many problems with the application of bulk materials- weak links, poor connectivity, small coherence length, oxygen content and control, environmental reactivity, phase stability, incongruent melting behavior, grain boundary contamination, brittle mechanical behavior, and flux creep. The extent to which these problems are intrinsic or associated with processing is the subject of controversy. This study seeks to understand solidification processing of these materials, and to use this knowledge for alternative processing strategies, which, at the very least, will improve the understanding of bulk material properties and deficiencies. In general, the phase diagram studies of the YBaCuO system have concentrated on solid state reactions and on the Y2BaCuO(x) + liquid yields YBa2Cu3O(7-delta) peritectic reaction. Little information is available on the complete melting relations, undercooling, and solidification behavior of these materials. In addition, rare earth substitutions such as Nd and Gd affect the liquidus and phase relations. These materials have promising applications, but lack of information on the high temperature phase relations has hampered research. In general, the understanding of undercooling and solidification of high temperature oxide systems lags behind the science of these phenomena in metallic systems. Therefore, this research investigates the fundamental melting relations, undercooling, and solidification behavior of oxide superconductors with an emphasis on improving ground based synthesis of these materials.

Derived from text

Spaceborne Experiments; Space Processing; Microgravity; Gravitational Effects; Superconductors (Materials); Thin Films; Solidification; Cooling; Containerless Melts

19990040295 Electronic Materials Engineering, Camarillo, CA USA

Dimensional Stability of Supermatrix Semiconductors

Holmes, D. E., Electronic Materials Engineering, USA; Cho, J. H., Electronic Materials Engineering, USA; NASA Microgravity Materials Science Conference; February 1999, pp. 319-323; In English; See also 19990040241; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Supermatrix Semiconductors (SMS) are in-situ composite semiconductor materials produced by directional solidification of eutectics in which the phases form in oriented, periodic, and crystallographically oriented arrays in 3 dimensions. SMS technology makes possible the 3-dimensional superlattice, the Quantum Cable, and materials with new or enhanced electronic, optoelectronic, electro-optic, and photorefractive properties. Objectives of the program are two-fold: (1) to demonstrate microgravity as an enabling environment for producing SMS materials with a high degree of microstructural control required for device applications; (2) to establish a broader scientific understanding of growth-property relationships of multi-phase solidification. to date, it has been demonstrated that the microstructure of the Ge/GeAs SMS is both dramatically and beneficially impacted when produced under conditions of simulated microgravity. Our approach to simulating microgravity conditions has been to apply magnetic damping to crystal growth from a small, low-Rayleigh-number melt. Three tasks have been addressed. First, a low-pressure Czochralski crystal growth system with an integrated 7 kgauss electromagnet has been designed and constructed and a liquid encapsulated growth process has been established for Ge/GeAs, the SMS chosen for study. Characterization of thermohydrodynamic properties of the encapsulated melt is the second program task. The third program task is to establish cause-effect relationships between microstructural features and conditions of solidification, including the solidification rate, crystal rotation, and magnetic field strength. Three important results have been obtained to date. First, dimensional stability depends on both seed rotation and magnet field strength. Second, the application of a magnetic field refines the microstructure, and the average inter-rod spacing decreases by about 30% under magnetic damping. Finally, a natural tendency of the microstructure in undamped growth to coarsen as solidification proceeds has been established.

Derived from text

Directional Solidification (Crystals); Eutectics; Semiconductors (Materials); Crystal Growth; Liquid Phases

19990040296 NASA Marshall Space Flight Center, Huntsville, AL USA

Effects of Microgravity on the Formation of Aerogels

Hunt, A. J., California Univ., Lawrence Berkeley Lab., USA; Ayers, M. R., California Univ., Lawrence Berkeley Lab., USA; Sibille, L., Universities Space Research Association, USA; Cronise, R. J., NASA Marshall Space Flight Center, USA; Noever, D. A., NASA Marshall Space Flight Center, USA; NASA Microgravity Materials Science Conference; February 1999, pp. 325-329; In English; See also 19990040241; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

This paper describes research to investigate fundamental aspects of the effects of microgravity on the formation of the microstructure of metal oxide alcogels and aerogels. We are studying the role of gravity on pore structure and gel uniformity in collaboration with Marshall Space Flight Center (MSFC) on gelling systems under microgravity conditions. While this project was just initiated in May 1998, related research performed earlier is described along with the plans and rationale for the current

microgravity investigation to provide background and describe newly developing techniques that should be useful for the current gellation studies. The role of gravity in materials processing must be investigated through the study of well-mastered systems. Sol-gel processed materials are near-perfect candidates to determine the effect of gravity on the formation and growth of random clusters from hierarchies of aggregated units. The processes of hydrolysis, condensation, aggregation and gellation in the formation of alcogels are affected by gravity and therefore provide a rich system to study under microgravity conditions. Supercritical drying of the otherwise unstable wet alcogel preserves the alcogel structure produced during sol-gel processing as aerogel. Supercritically dried aerogel provides for the study of material microstructures without interference from the effects of surface tension, evaporation, and solvent flow. Aerogels are microstructured, low density open-pore solids. They have many unusual properties including: transparency, excellent thermal resistance, high surface area, very low refractive index, a dielectric constant approaching that of air, and extremely low sound velocity. Aerogels are synthesized using sol-gel processing followed by supercritical solvent extraction that leaves the original gel structure virtually intact. These studies will elucidate the effects of microgravity on the homogeneity of the microstructure and porosity of aerogel. The presence of poorly controlled microporosity in aerogel leads to material non-uniformity that gives rise to increased light scattering. Investigation of the effect of gravity driven solute flows within microclusters and their effect on condensation and agglomeration reactions will enable us to improve the preparation and properties of aerogel. Increased clarity of images viewed through aerogel and decreased scattering from the pores of aerogel will significantly improve the prospects for large-scale adoption of aerogel in such applications as transparent insulating windows, high performance thermal insulation, and Cherenkov detectors.
Derived from text
Microgravity; Gravitational Effects; Aerogels; Gelation; Porous Materials

19990040297 Arizona Univ., Dept. of Materials Science and Engineering, Tucson, AZ USA
Non-Equilibrium Phase Transformations
Jackson, Kenneth A., Arizona Univ., USA; NASA Microgravity Materials Science Conference; February 1999, pp. 331-336; In English; See also 19990040241; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

The goal of this research is to develop an understanding of the structure and properties of multicomponent materials produced by phase transformations which occur under conditions which are far from equilibrium. These conditions often produce segregation effects and microstructures which are quite different from those produced by near-equilibrium transformations. The development of a sound physical understanding of these non-equilibrium phase transformations in alloys is perhaps the most important and challenging outstanding basic problem in materials science today. There have been many experimental studies designed specifically to explore this specifically to explore this regime, but the underlying physical processes have not been properly understood. Ad hoc equations have been used to fit experimental data and these have remained essentially unchanged for the past decade. We are using Monte Carlo modeling based on the Ising model to study these crystallization processes in alloys. These are similar to the simulations which played a major role in developing our understanding of the atomic level processes which control the crystallization of pure materials. The computer modeling provides a powerful tool to help us to understand the experimental results, to develop a detailed understanding of the processes involved, and as a predictive tool for guiding experiment. The model outlined in the paper predicts a non-equilibrium k-value which compares well with Monte Carlo computer simulations and with experimental results. The quantities involved in Beta are known or can be estimated for many systems, and so the magnitude and onset of non-equilibrium effects can be predicted from these equations. Although relevant experimental data are limited, the factor A in equations 3 and 4 seems to be independent of the alloy system within the limitations imposed by uncertainties in the values of the materials parameters involved. The model seems to have significant predictive capabilities, and can be used to predict velocity-dependent ”kinetic” phase diagrams, which define the range of applicability of the quasi-equilibrium model and can be used to predict the extended solid solubilities found during rapid crystallization, as well as non-equilibrium distribution coefficients.
Derived from text
Mathematical Models; Computerized Simulation; Crystallization; Phase Transformations; Ising Model; Monte Carlo Method; Alloys; Nonequilibrium Conditions; Crystal Growth

19990040298 California Inst. of Tech., Keck Lab., Pasadena, CA USA
Physical Properties and Processing of Undercooled Metallic Glass Forming Liquids
Johnson, W. L., California Inst. of Tech., USA; Lee, D. S., California Inst. of Tech., USA; Hays, C., California Inst. of Tech., USA; Schroers, J., California Inst. of Tech., USA; NASA Microgravity Materials Science Conference; February 1999, pp. 337-342; In English; See also 19990040241; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

The High Vacuum Electrostatic Levitation (HVESL) technique as developed by Rhim and collaborators at Jet Propulsion Laboratory provides a method of levitating metallic alloy droplets of size ranging up to several mm under high vacuum conditions with relatively quiescent conditions. The levitated sample can be heated and melted using either a focused quartz lamp or a laser.

When combined with non contact temperature measurements, such a system provides an ideal platform for the study of liquid metals and alloys under ultra-clean and containerless conditions. The HVESL method has been initially applied to the study of the undercooling behavior and thermophysical properties of metallic glass forming liquids in both the equilibrium liquid and undercooled states. Studies of crystal nucleation and growth kinetics in undercooled glass forming liquids have enabled direct measurements of the CCT and TTT-diagrams throughout the undercooled liquid range for a number of bulk metallic glass forming systems. As a representative example, technique has been used to directly quantify the influence of low level impurities (e.g. oxygen) on the crystal nucleation kinetics in a bulk metallic glass forming system. Preliminary experiments, suggest that it is feasible to implement an AC modulation calorimetry measurement on the HVESL platform. We are also examining the potential use of the HVESL platform to carry out studies of atomic diffusion and thermal transport in bulk metallic glass forming liquids.
Author
Levitation Melting; Crystal Growth; High Vacuum; Liquid Metals; Metallic Glasses; Supercooling; Time Temperature Parameter; Levitation

19990040299 California Inst. of Tech., Keck Lab., Pasadena, CA USA
Thermo-Physical Properties of Undercooled Metallic Glass Forming Alloys: An Experiment on MSL-1
Glade, S. C., California Inst. of Tech., USA; Lee, D. S., California Inst. of Tech., USA; Johnson, W. L., California Inst. of Tech., USA; Wunderlich, R. K., Technische Univ., Germany; Fecht, H. J., Technische Univ., Germany; NASA Microgravity Materials Science Conference; February 1999, pp. 343-349; In English; See also 19990040241; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

Thermophysical properties of two bulk metallic glass forming alloys, Ti34Zr11Cu47Ni8 (VIT 101) and Zr57Nb5Ni(l2.6)Al10Cu(15.4) (VIT 106), were investigated in the stable and undercooled melt. Our investigation focused on measurements of the specific heat in the stable and undercooled liquid using the method of AC modulation calorimetry. The VIT 106 exhibited a maximum undercooling of 140 K in free radiative cooling. Specific heat measurements could be performed in stable melt down to an undercooling of 80 K. Analysis of the specific heat data indicate an anomaly near the equilibrium liquidus temperature. This anomaly is also observed in the temperature dependencies of the external relaxation time, the specific volume, and the surface tension; it is tentatively attributed to a phase separation in the liquid state. The VIT 101 specimen exhibited a small undercooling of about 50 K. Specific heat measurements were performed in the stable and undercooled melt. These various results will be combined with ground based work such as the measurement of T-T-T curves in the electrostatic levitator and low temperature viscosity and specific heat measurements for modeling the nucleation kinetics of these alloys.
Author
Spaceborne Experiments; Space Processing; Microgravity; Gravitational Effects; Metallic Glasses; Alloys; Supercooling; Thermophysical Properties; Melts (Crystal Growth)

19990040301 Northeastern Univ., Dept. of Physics, Boston, MA USA
Role of Dynamic Nucleation at Moving Boundaries in Phase and Microstructure Selection
Karma, Alain, Northeastern Univ., USA; Trivedi, Rohit, Ames Lab., USA; NASA Microgravity Materials Science Conference; February 1999, pp. 359-364; In English; See also 19990040241
Contract(s)/Grant(s): NAG8-1254; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

Solidification microstructures that form under steady-state growth conditions (cells, dendrites, regular eutectics, etc.) are reasonably well understood in comparison to other, more complex microstructures, which form under intrinsically non-steady-state growth conditions due to the competition between the nucleation and growth of several phases. Some important practical examples in this latter class include microstructures forming in peritectic systems in highly undercooled droplets, and in strip cast stainless steels. Prediction of phase and microstructure selection in these systems has been traditionally based on (1) heterogeneous nucleation on a static interface, and (2) comparing the relative growth rate of different phase/microstructures under steady-state growth conditions. The formation of new phases, however, occurs via nucleation on, or ahead of, a moving boundary. In addition, the actual selection process is controlled by a complex interaction between the nucleation process and the growth competition between the nuclei and the pre-existing phase under non-steady-state conditions. As a result, it is often difficult to predict which microstructure will form and which phases will be selected under prescribed processing conditions. This research addresses this critical role of nucleation at moving boundaries in the selection of phases and solidification microstructures through quantitative experiments and numerical modeling in peritectic systems. In order to create a well characterized system in which to study this problem, we focus on the directional solidification of hypo- and hyper-peritectic alloys in the two-phase region, imposing a large enough ratio of temperature gradient/growth rate (G/V(sub p)) to suppress the morphological instability of both the parent (alpha) and peritectic (Beta) phases, i.e. each phase alone would grow as a planar front. Our combined experimental and theoretical results

show that, already in this simplified case, the growth competition of these two phases leads to a rich variety of microstructures that depend sensitively upon the relative importance of nucleation, diffusion, and convection.
Derived from text
Heterogeneity; Microstructure; Nucleation; Steady State; Convection; Crystal Growth; Mathematical Models; Experimentation

19990040302 NASA Langley Research Center, Hampton, VA USA
Effect of Marangoni Convection Generated by Voids on Segregation During Low-G and 1-G Solidification
Kassemi, M., National Center for Microgravity Research on Fluids and Combusiton, USA; Fripp, A., NASA Langley Research Center, USA; Rashidnia, N., National Center for Microgravity Research on Fluids and Combusiton, USA; deGroh, H., NASA Lewis Research Center, USA; NASA Microgravity Materials Science Conference; February 1999, pp. 365-370; In English; See also 19990040241; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

Solidification experiments, especially microgravity solidification experiments are often hampered by the evolution of unwanted voids or bubbles in the melt. Although these voids and/or bubbles are highly undesirable, there are currently no effective means of preventing their formation or eliminating their adverse effects, particularly, during low-g experiments. Marangoni Convection caused by these voids can drastically change the transport processes in the melt and, therefore, introduce enormous difficulties in interpreting the results of the space investigations. Recent microgravity experiments by Matthiesen, Andrews, and Fripp are all good examples of how the presence of voids and bubbles affect the outcome of costly space experiments and significantly increase the level of difficulty in interpreting their results. In this work we examine mixing caused by Marangoni convection generated by voids and bubbles in the melt during both 1-g and low-g solidification experiments. The objective of the research is to perform a detailed and comprehensive combined numerical-experimental study of Marangoni convection caused by voids during the solidification process and to show how it can affect segregation and growth conditions by modifying the flow, temperature, and species concentration fields in the melt. While Marangoni convection generated by bubbles and voids in the melt can lead to rapid mixing that would negate the benefits of microgravity processing, it could be exploited in some terrestrial processing to ensure effective communication between a melt/solid interface and a gas phase stoichiometry control zone. Thus we hope that this study will not only aid us in interpreting the results of microgravity solidification experiments hampered by voids and bubbles but to guide us in devising possible means of minimizing the adverse effects of Marangoni convection in future space experiments or of exploiting its beneficial mixing features in ground-based solidification.
Derived from text
Spaceborne Experiments; Space Processing; Microgravity; Gravitational Effects; Marangoni Convection; Voids; Solidification; Bubbles

19990040303 NASA Lewis Research Center, Cleveland, OH USA
Identification of Gravity-Related Effects on Crystal Growth From Melts With an Immiscibility Gap
Kassemi, M., National Center for Microgravity Research on Fluids and Combusiton, USA; Sayir, A., Case Western Reserve Univ., USA; Farmer, S., NASA Lewis Research Center, USA; NASA Microgravity Materials Science Conference; February 1999, pp. 371-376; In English; See also 19990040241; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

This work involves an experimental-numerical approach to study the effects of natural and Marangoni convections on solidification of single crystals from a silicate melt with a liquid-liquid immiscibility gap. Industrial use of crystals grown from silicate melts is becoming increasingly important in electronic, optical, and high temperature structural applications. Even the simplest silicate systems like Al203-SiO2 have had, and will continue to have, a significant role in the development of traditional and advanced ceramics. A unique feature of crystals grown from the silicate systems is their outstanding linear electro-optic properties. They also exhibit exceptionally high optical rotativity. As a result, these crystals are attractive materials for dielectric, optical, and microwave applications. Experimental work in our laboratory has indicated that directional solidification of a single crystal mullite appears to be preceded by liquid-liquid phase separation in the melt. Disruption of the immiscible state results in crystallization of a two phase structure. There is also evidence that mixing in the melt caused by density-driven convection can significantly affect the stability of the immiscible liquid layers and result in poly-crystalline growth. On earth, the immiscible state has only been observed for small diameter crystals grown in float zone systems where natural convection is almost negligible. Therefore, it is anticipated that growth of large single crystals from silicate melts would benefit from microgravity conditions because of the reduction of the natural convective mixing. The main objective of this research is to determine the effects of transport processes on the phase separation in the melt during growth of a single crystal while addressing the following issues: (1) When do the immis-

cible layers form and are they real?; (2) What are the main physical characteristics of the immiscible liquids?; and (3) How mixing by natural or Marangoni convection affects the stability of the phase separated melt.
Derived from text
Microgravity; Gravitational Effects; Solubility; Crystal Growth; Directional Solidification (Crystals); Melts (Crystal Growth); Marangoni Convection; Single Crystals; Mullites; Free Convection; Liquid-Liquid Interfaces

19990040304 Johns Hopkins Univ., Dept. of Chemical Engineering, Baltimore, MD USA
Measurement of Liquid-to-Solid Nucleation Rates in Undercooled Metallic Melts
Katz, Joseph L., Johns Hopkins Univ., USA; NASA Microgravity Materials Science Conference; February 1999, pp. 377-380; In English; See also 19990040241; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

The main objective of this work is to obtain quantitative experimental measurements of liquid-to-crystal homogeneous nucleation rates of undercooled metallic melts. Some of the industrial melt and resolidification processes that involve nucleation phenomena heavily rely on a detailed understanding and control of either heterogeneous or homogeneous nucleation rates to produce a desired phase or microstructure. Avoiding or delaying nucleation enables the materials scientist to produce fine dispersions of second phase particles, to extend solubility limits, to refine the material's microstructure to the nanometer size range, and to synthesize novel crystalline and amorphous phases. Experimental difficulties are encountered when working with molten metals. In particular, it has not been possible to either eliminate or fully characterize the foreign surfaces presented to the melt by particles, container walls, or by suspending liquids. Thus, there is significant interest in removing these surfaces by containerless processing of metals. This study uses a novel experimental technique that allows a small metallic droplet to be formed, solidified, and remelted in high vacuum without any physical contact. Temperature is measured by pyrometry. The same experimental apparatus should be capable of: (1) exposing droplets to controlled levels of gaseous reactants and/or particulate additives in order to make quantitative measurements of their influence on crystal nucleation; (2) making quantitative measurements of critical cooling rates and time-temperature-transformation diagrams for metallic glass-forming alloys; and (3) investigating whether there is a correlation between overheating and the undercooling limit. This research will have several valuable outcomes: It will support the wide variety of solidification experiments of interest to microgravity investigators around the world. It can test theories for liquid-to-crystal nucleation in metallic melts. It can quantify the effect of some common trace impurities on crystal nucleation. In addition, this work, in conjunction with NASA's overall Microgravity Materials Science Program, will have a beneficial effect on countless industrial processes that involve the melting and resolidification of metals to produce useful materials.
Derived from text
Microstructure; Melts (Crystal Growth); Liquids; Nucleation; Supercooling; Metallic Glasses; Microgravity; Levitation

19990040305 Washington Univ., Dept. of Physics, Saint Louis, MO USA
Composition Effects on Phase Formation and Stability
Kelton, Kenneth F., Washington Univ., USA; NASA Microgravity Materials Science Conference; February 1999, pp. 381-386; In English; See also 19990040241
Contract(s)/Grant(s): NCC8-85; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

In this report, results from experimental studies of the composition dependence of nucleation are presented. A model for nucleation that takes simultaneous account of the interfacial attachment processes at the growing cluster interface and diffusion into the region surrounding the developing cluster is presented and numerical results are discussed.
Derived from text
Diffusion; Nucleation; Crystallization; Phase Transformations; Phase Stability (Materials); Silica Glass; Metallic Glasses; Supercooling; Kinetics; Mathematical Models

19990040306 NASA Lewis Research Center, Cleveland, OH USA
The Transient Dendritic Solidification Experiment (TDSE)
Koss, M. B., Rensselaer Polytechnic Inst., USA; Glicksman, M. E., Rensselaer Polytechnic Inst., USA; LaCombe, J. C., Rensselaer Polytechnic Inst., USA; Chait, A., NASA Lewis Research Center, USA; Pines, V., NASA Lewis Research Center, USA; NASA Microgravity Materials Science Conference; February 1999, pp. 387-392; In English; See also 19990040241; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

The study of steady-state dendritic growth has both validated many element of transport phenomena in dendritic growth, and yielded many new insights. Further development in simulation and modeling are needed, as is further understanding of the role of selection or scaling in dendritic growth. The TDSE contributes to the further study of dendritic phenomena by carefully measuring and modeling transient effects on dendritic growth. The major challenge encountered in measuring and analyzing the transient behavior of isothermal dendrites is defining precisely the initial conditions from which or to which the dendrite evolves. Our pro-

posed pressure-mediated TDSE microgravity experiment, obviates this difficulty, because the transient occurs between two well-characterized steady-states, rather than between an ill-defined initial state and the final steady state. The major results expected are unique data on transient behavior that will extend the scientific bounds from the now well-understood thermal effects, and provide insight into interfacial dynamics where open questions remain.
Derived from text
Dendritic Crystals; Solidification; Microgravity; Melting Points; Crystal Growth; Crystallization; Transport Properties

19990040307 Wisconsin Univ., Dept. of Materials Science and Engineering, Madison, WI USA
Physical Simulation of Marangoni Convection in Weld Pools
Limmaneevichitr, C., Wisconsin Univ., USA; Kou, S., Wisconsin Univ., USA; NASA Microgravity Materials Science Conference; February 1999, pp. 393-398; In English; See also 19990040241; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

Marangoni convection was observed in simulated weld pools of transparent molten NaNO3. Marangoni convection was induced by touching the center of the pool surface with a hot wire to raise its temperature above that at the edge of the pool surface. The cores of the flow loops were close to the pool surface, where fluid flow was much faster and the flow lines were much more closely spaced than in the bulk pool, thus suggesting that convection in these pools was dominated by Marangoni convection. The flow loops were stable and essentially axisymmetric. When the surface temperature difference was reduced, however, convection weakened and the flow loops could not retain stability and axisymmetry.
Author
Fluid Flow; Marangoni Convection; Surface Temperature; Temperature Gradients; Welding; Gravitational Effects; Flow Visualization

19990040309 State Univ. of New York, Materials Science and Engineering Dept., Stony Brook, NY USA
Orbital Processing of Eutectic Rod-like Arrays (OPERA)
Larson, David J., Jr., State Univ. of New York, USA; Zheng, Lili, State Univ. of New York, USA; Zhang, Hui, State Univ. of New York, USA; NASA Microgravity Materials Science Conference; February 1999, pp. 407-408; In English; See also 19990040241; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

The objective of this program is to utilize the orbital microgravity environment to conduct unique experiments to evaluate process models that describe convective influences on solidification of regular, low volume fraction, eutectic alloys. These models include a generic model of lamellar and rod-like eutectic solidification and complementary models that concern current interface demarcation and the influences of Soret transport on eutectic and off-eutectic solidification. Experimentally, we will directionally solidify regular eutectic structures in orbit (microgravity) and terrestrially (1-g) under magnetically damped and undamped conditions. We will simultaneously apply in-situ diagnostics to monitor and perturb the solidification interface velocity using current interface demarcation and to precisely monitor the temperature at the solidification interface using Seebeck measurements or subminiature thermocouple arrays. Comparative quantitative sample and data analyses will determine the relations between the velocity, interface temperature (undercooling), and structural parameters (rod diameter and inter-rod spacing) in microgravity (microgravity) and in unit gravity (1-g) under magnetically damped and undamped conditions.
Derived from text
Microgravity; Gravitational Effects; Eutectic Alloys; Convective Flow; Quantitative Analysis; Models; Crystal Growth; Directional Solidification (Crystals)

19990040310 NASA Marshall Space Flight Center, Huntsville, AL USA
Orbital Processing of High-Quality Zn-Alloyed CdTe Compound Semiconductors
Larson, David J., Jr., State Univ. of New York, USA; Dudley, M., State Univ. of New York, USA; Raghothamachar, B., State Univ. of New York, USA; Alexander, J. I. D., Case Western Reserve Univ., USA; Carlson, F. M., Clarkson Univ., USA; Gillies, D., NASA Marshall Space Flight Center, USA; Volz, M., NASA Marshall Space Flight Center, USA; Ritter, T. M., North Carolina Univ., USA; DiMarzio, D., Northrop Grumman Corp., USA; NASA Microgravity Materials Science Conference; February 1999, pp. 409-410; In English; See also 19990040241; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

The objective of this research is to investigate the influences of gravitationally-dependent phenomena (hydrostatic and buoyant) on the growth and quality of doped and alloyed Cadmium-Zinc-Telluride (CdZnTe) crystals grown by the modified seeded Bridgman-Stockbarger technique. It is hypothesized that the damping of the gravitationally-dependent buoyancy convection will

substantially enhance chemical homogeneity and the near-elimination of hydrostatic pressure will enable significant reduction in defect (dislocations and twins) density.
Derived from text
Microgravity; Gravitational Effects; Doped Crystals; Semiconductors (Materials); Crystal Growth; Spaceborne Experiments; Space Processing; Hydrostatic Pressure; Buoyancy

19990040313 Illinois Univ., Dept. of Materials Science and Engineering, Urbana, IL USA
Colloidal Stability in Complex Fluids
Lewis, Jennifer A., Illinois Univ., USA; NASA Microgravity Materials Science Conference; February 1999, pp. 419-424; In English; See also 19990040241; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

The broad objective of this ground-based research program is to develop a fundamental understanding of factors governing the stability of complex colloidal suspensions. Such systems are utilized in numerous applications including advanced ceramics, coatings, inks, and paints. Specifically, this research aims to investigate the effects of depletion phenomena, which arise between large colloidal particles in solutions containing smaller particles, on the stability, structural evolution, and rheological properties of such complex systems. This ground-based research effort will benefit from a microgravity environment because complications from particle-size or density-driven segregation in suspension would be minimized allowing for a broader range of experimental conditions to be probed.
Derived from text
Microgravity; Gravitational Effects; Colloids; Solid Suspensions; Complex Systems; Depletion

19990040314 Washington State Univ., School of Mechanical and Materials Engineering, Pullman, WA USA
A Comparative Modeling Study of Magnetic and Electrostatic Levitation in Microgravity
Li, Ben Q., Washington State Univ., USA; NASA Microgravity Materials Science Conference; February 1999, pp. 425-430; In English; See also 19990040241; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

Numerical models are developed to represent the complex electrodynamic and hydrodynamic phenomena in magnetically and electrostatically levitated droplets in microgravity environment. The numerical model development will be based on the solution of the Maxwell equations using either the boundary element technique or the coupled boundary/finite element technique and the solution of the Navier-Stokes equations and energy/mass balance equations by the finite element method. With developed models, magnetically and electrostatically levitated droplets are studied in a comparative fashion to understand the following key issues concerning their space applications: (1) viscous surface oscillation and heat transfer of droplets levitated magnetically or electrostatically; (2) turbulent flow behavior in magnetically-levitated droplets; (3) internal fluid flows and heat transfer in electrostatically levitated droplets; and (4) stability of droplets levitated magnetically or electrostatically.
Author
Microgravity; Gravitational Effects; Mathematical Models; Finite Element Method; Boundary Element Method; Maxwell Equation; Navier-Stokes Equation; Levitation; Electrostatics; Magnetic Fields; Drops (Liquids)

19990040315 NASA Lewis Research Center, Cleveland, OH USA
Study of Magnetic Damping Effect on Convection and Solidification Under G-Jitter Conditions
Li, Ben Q., Louisiana State Univ., USA; deGroh, H. C., III, NASA Lewis Research Center, USA; NASA Microgravity Materials Science Conference; February 1999, pp. 431-436; In English; See also 19990040241; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

As shown by NASA resources dedicated to measuring residual gravity (SAMS and OARE systems), g-jitter is a critical issue affecting space experiments on solidification processing of materials. This study aims to provide, through extensive numerical simulations and ground based experiments, an assessment of the use of magnetic fields in combination with microgravity to reduce the g-jitter induced convective flows in space processing systems. We have so far completed asymptotic analyses based on the analytical solutions for g-jitter driven flow and magnetic field damping effects for a simple one-dimensional parallel plate configuration, and developed both 2-D and 3-D numerical models for g-jitter driven flows in simple solidification systems with and without presence of an applied magnetic field. Numerical models have been checked with the analytical solutions and have been applied to simulate the convective flows and mass transfer using both synthetic g-jitter functions and the g-jitter data taken from space flight. Some useful findings have been obtained from the analyses and the modeling results. Some key points may be summarized as follows: (1) the amplitude of the oscillating velocity decreases at a rate inversely proportional to the g-jitter frequency and with an increase in the applied magnetic field; (2) the induced flow approximately oscillates at the same frequency as the affecting g-jitter, but out of a phase angle; (3) the phase angle is a complicated function of geometry, applied magnetic field, temperature gradient and frequency; (4) g-jitter driven flows exhibit a complex fluid flow pattern evolving in time; (5) the damping

effect is more effective for low frequency flows; and (6) the applied magnetic field helps to reduce the variation of solutal distribution along the solid-liquid interface. Work in progress includes numerical simulations and ground-based measurements. Both 2-D and 3-D numerical simulations are being continued to obtain further information on g-jitter driven flows and magnetic field effects. A physical model for ground-based measurements is completed and some measurements of the oscillating convection are being taken on the physical model. The comparison of the measurements with numerical simulations is in progress. Additional work planned in the project will also involve extending the 2-D numerical model to include the solidification phenomena with the presence of both g-jitter and magnetic fields.
Derived from text
Spaceborne Experiments; Space Processing; Microgravity; Gravitational Effects; Mathematical Models; Computerized Simulation; Magnetic Fields; Damping; Convective Flow; Solidification; Magnetic Effects; Vibration; Finite Element Method

19990040317 Case Western Reserve Univ., Cleveland, OH USA
Diffusion Processes in Molten Semiconductors
Matthiesen, David H., Case Western Reserve Univ., USA; Kaforey, Monica L., Case Western Reserve Univ., USA; NASA Microgravity Materials Science Conference; February 1999, pp. 443-449; In English; See also 19990040241; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

For the reflight of the first Microgravity Science Laboratory (MSL-1R) flight of opportunity, this program of study was directed at the fundamental and applied issues pertaining to diffusion of mass in the liquid state as driven by concentration gradients (Fickian diffusion). The fundamental material systems of interest for the MSL-1 mission were the dilute binary systems of gallium (Ga), silicon (Si) and antimony (Sb) into germanium (Ge). This research program consisted of three major components: an experimental measurement portion, a continuum numerical simulation portion and an atomistic numerical simulation portion. The experimental measurement portion was designed to provide definitive measurements of the purely diffusive component of mass transfer in molten semiconductor systems. The shear cell technique was used to directly measure the diffusion coefficients in semiconductor melts. For the Fickian diffusion case, isothermal measurements were used to determine the diffusion coefficients. An experimental matrix was used to determine the dependence of the diffusion coefficients on temperature, dopant type and column diameter. For the MSL-1 mission, the experiments contained a ”check” to quantify, if any, the amount of Soret diffusion driven by the small thermal gradients in the Large Isothermal Furnace (LIF).
Derived from text
Spaceborne Experiments; Space Processing; Microgravity; Gravitational Effects; Melts (Crystal Growth); Semiconductors (Materials); Diffusion; Mass Transfer; Diffusion Coefficient; Binary Systems (Materials)

19990040318 Case Western Reserve Univ., Cleveland, OH USA
The Study of Dopant Segregation Behavior During the Growth of GaAs in Microgravity
Matthiesen, David H., Case Western Reserve Univ., USA; Kaforey, Monica L., Case Western Reserve Univ., USA; Bly, Jennifer, Case Western Reserve Univ., USA; NASA Microgravity Materials Science Conference; February 1999, pp. 451-456; In English; See also 19990040241; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

The original proposal for the study of dopant segregation behavior during the growth of gallium arsenide (GaAs) in microgravity was a program to investigate techniques for obtaining complete axial and radial dopant uniformity during crystal growth of selenium doped gallium arsenide (Se/GaAs). The primary goal of the reflight opportunity on the Second USA Microgravity Laboratory (USML-2) was to characterize and, if possible, controllably modify the melt-solid interface shape during the growth of Se/GaAs to achieve uniform radial segregation of the dopant. The reduced effective gravitational accelerations in a microgravity environment can reduce or eliminate the driving force for buoyancy driven convection. As the level of convection is reduced, axial segregation approaches that of diffusion controlled growth. An axial segregation profile due to diffusion controlled growth will have a uniform steady state region after an initial transient. Radial segregation, however, is controlled by the shape of the melt-solid interface. In these experiments, the booster heater and gradient zone configuration of NASA’s Crystal Growth Furnace (CGF) were utilized in an attempt to achieve a near planar interface shape in order to minimize radial dopant variation.
Derived from text
Spaceborne Experiments; Space Processing; Microgravity; Gravitational Effects; Crystal Growth; Doped Crystals; Gallium Arsenides; Diffusion

19990040320 University of Southern California, Dept. of Aerospace Engineering, Los Angeles, CA USA
Experimental Studies of the Interaction Between a Parallel Shear Flow and a Directionally-Solidifying Front
Zhang, Meng, University of Southern California, USA; Maxworthy, Tony, University of Southern California, USA; NASA

Microgravity Materials Science Conference; February 1999, pp. 463-468; In English; See also 19990040241
Contract(s)/Grant(s): NAG3-1619; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

It has long been recognized that flow in the melt can have a profound influence on the dynamics of a solidifying interface and hence the quality of the solid material. In particular, flow affects the heat and mass transfer, and causes spatial and temporal variations in the flow and melt composition. This results in a crystal with nonuniform physical properties. Flow can be generated by buoyancy, expansion or contraction upon phase change, and thermo-soluto capillary effects. In general, these flows can not be avoided and can have an adverse effect on the stability of the crystal structures. This motivates crystal growth experiments in a microgravity environment, where buoyancy-driven convection is significantly suppressed. However, transient accelerations (g-jitter) caused by the acceleration of the spacecraft can affect the melt, while convection generated from the effects other than buoyancy remain important. Rather than bemoan the presence of convection as a source of interfacial instability, Hurle in the 1960s suggested that flow in the melt, either forced or natural convection, might be used to stabilize the interface. Delves considered the imposition of both a parabolic velocity profile and a Blasius boundary layer flow over the interface. He concluded that fast stirring could stabilize the interface to perturbations whose wave vector is in the direction of the fluid velocity. Forth and Wheeler considered the effect of the asymptotic suction boundary layer profile. They showed that the effect of the shear flow was to generate travelling waves parallel to the flow with a speed proportional to the Reynolds number. There have been few quantitative, experimental works reporting on the coupling effect of fluid flow and morphological instabilities. Huang studied plane Couette flow over cells and dendrites. It was found that this flow could greatly enhance the planar stability and even induce the cell-planar transition. A rotating impeller was buried inside the sample cell, driven by an outside rotating magnet, in order to generate the flow. However, it appears that this was not a well-controlled flow and may also have been unsteady. In the present experimental study, we want to study how a forced parallel shear flow in a Hele-Shaw cell interacts with the directionally solidifying crystal interface. The comparison of experimental data show that the parallel shear flow in a Hele-Shaw cell has a strong stabilizing effect on the planar interface by damping the existing initial perturbations. The flow also shows a stabilizing effect on the cellular interface by slightly reducing the exponential growth rate of cells. The left-right symmetry of cells is broken by the flow with cells tilting toward the incoming flow direction. The tilting angle increases with the velocity ratio. The experimental results are explained through the parallel flow effect on lateral solute transport. The phenomenon of cells tilting against the flow is consistent with the numerical result of Dantzig and Chao.

Derived from text

Shear Flow; Parallel Flow; Directional Solidification (Crystals); Liquid-Solid Interfaces; Melts (Crystal Growth); Crystal Growth; Single Crystals; Interface Stability

19990040322 Illinois Univ., Dept. of Mechanical Engineering, Chicago, IL USA

Microgravity Investigation of Dynamic Oxygen Adsorption in Molten Solder Jetting Technology

Megaridis, C. M., Illinois Univ., USA; McNallan, M., Illinois Univ., USA; Wallace, D. B., Microfab Technologies, Inc., USA; NASA Microgravity Materials Science Conference; February 1999, pp. 475-480; In English; See also 19990040241; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

Surface forces play a critical role in fluid dynamical phenomena which are important in materials processing. These forces are generally more important in liquid-metal systems, than in their ceramic or polymer counterparts, because of the high surface tensions of metal melts in comparison to other classes of materials. The surface tension of liquid metals has been found to be very susceptible to small amounts of adsorbed oxygen. Consequently, the kinetics of oxygen adsorption can influence the capillary breakup of liquid-metal jets targeted for use in electronics assembly applications where low-melting-point metals (such as tin-containing solders) are utilized as an attachment and/or structural material for mounting of electronic components to substrates. By interpreting values of surface tension measured at various surface ages, adsorption and diffusion rates of oxygen on the surface of the melt can be estimated. In this newly-commenced research program, the adsorption of oxygen on the surface of an atomizing molten-metal jet will be investigated as posing a severe impediment in processing technologies involving jetting of pure tin or tin-based alloys.

Derived from text

Adsorption; Interfacial Tension; Solders; Microgravity; Oxygen; Soldering; Gas-Metal Interactions; Liquid Metals

19990040327 NASA Marshall Space Flight Center, Huntsville, AL USA

Gravitational Effects on the Morphology and Kinetics of Photodeposition of Polydiacetylene Thin Films From Monomer Solutions

Paley, Mark S., Universities Space Research Association, USA; Antar, Basil, Tennessee Univ. Space Inst., USA; Witherow, William K., NASA Marshall Space Flight Center, USA; Frazier, Donald O., NASA Marshall Space Flight Center, USA; NASA

Microgravity Materials Science Conference; February 1999, pp. 501-505; In English; See also 19990040241; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

The goal of this proposed work is to study gravitational effects on the photodeposition of polydiacetylene thin films from monomer solutions onto transparent substrates. Polydiacetylenes have been an extensively studied class of organic polymers because they exhibit many unusual and interesting properties, including electrical conductivity and optical nonlinearity. Their long polymeric chains render polydiacetylenes readily conducive to thin film formation, which is necessary for many applications. These applications require thin polydiacetylene films possessing uniform thicknesses, high purity, minimal inhomogeneities and defects (such as scattering centers), etc. Also, understanding and controlling the microstructure and morphology of the films is important for optimizing their electronic and optical properties. The lack of techniques for processing polydiacetylenes into such films has been the primary limitation to their commercial use. We have recently discovered a novel method for the formation of polydiacetylene thin films using photo-deposition from monomer solutions onto transparent substrates with UV light. This technique is very simple to carry out, and can yield films with superior quality to those produced by conventional methods. Furthermore, these films exhibit good third-order properties and are capable of waveguiding. We have been actively studying the chemistry of diacetylene polymerization in solution and the photo-deposition of polydiacetylene thin films from solution. It is well-known that gravitational factors such as buoyancy-driven convection and sedimentation can affect chemical and mass transport processes in solution. One important aspect of polydiacetylene thin film photodeposition in solution, relevant to microgravity science, is that heat generated by absorption of UV radiation induces thermal density gradients that under the influence of gravity, can cause fluid flows (buoyancy-driven convection). Additionally, changes in the chemical composition of the solution during polymerization may cause solutal convection. These fluid flows affect transport of material to and from the film surface and thereby affect the kinetics of the growth process. This manifests itself in the morphology of the resulting films; films grown under the influence of convection tend to have less uniform thicknesses, and can possess greater inhomogeneities and defects. Specifically, polydiacetylene films photodeposited from solution, when viewed under a microscope, exhibit very small particles of solid polymer which get transported by convection from the bulk solution to the surface of the growing film and become embedded. Even when carried out under conditions designed to minimize unstable density gradients (i.e., irradiating the solution from the top), some fluid flow still takes place (particles remain present in the films). It is also possible that defect nucleation may be occurring within the films or on the surface of the substrate; this, too, can be affected by convection (as is the case with crystal growth). Hence films grown in 1-g will, at best, still possess some defects. The objective of this proposal is to investigate, both in 1-g and in low-g, the effects of gravitational factors (primarily convection) on the dynamics of these processes, and on the quality, morphology, and properties of the films obtained.

Derived from text

Microgravity; Gravitational Effects; Deposition; Monomers; Optical Properties; Polyacetylene; Convection; Thin Films; Morphology; Kinetics

19990040329 Wisconsin Univ., Madison, WI USA

Analysis of Containerless Processing and Solidification Microstructures

Perepezko, J. H., Wisconsin Univ., USA; NASA Microgravity Materials Science Conference; February 1999, pp. 513-519; In English; See also 19990040241; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

The main research objective is the evaluation and analysis of the undercooling and resultant solidification microstructures after containerless processing, including drop tube processing and levitation melt processing of selected alloys. The results are intended for use as an experience base for the design of future space-based microgravity experiments. Containerless solidification processing of materials in space requires an understanding of the critical variables affecting solidification. Perhaps the most fundamental parameter in solidification processing is the level of melt undercooling prior to solidification. The containerless environment removes a major source of impurities and heterogeneous nucleation sites, allowing for a large melt undercooling. Containerless processing in ground-based drop tubes simulates the microgravity conditions via solidification of liquid droplets under free fall conditions. The enhanced liquid undercooling exposes alternate solidification pathways, allowing for the formation of novel phases and microstructures. Controlling the undercooling level provides some control of the operative solidification pathway and the resultant microstructure. The results of the ground based drop tube study are being used to identify critical processing variables and possible product phases in microgravity studies, and the analysis may be used to design and predict the science requirements for space experiments.

Derived from text

Cooling; Gravitational Effects; Melts (Crystal Growth); Microgravity; Microstructure; Nucleation; Solidification; Space Processing; Spaceborne Experiments; Containerless Melts

19990040331 University of Southern Mississippi, Dept. of Chemistry and Biochemistry, Hattiesburg, MS USA
Frontal Polymerization in Microgravity
Pojman, John A., University of Southern Mississippi, USA; NASA Microgravity Materials Science Conference; February 1999, pp. 527-532; In English; See also 19990040241; Sponsored in part by the Mississippi NASA EPSCoR Program
Contract(s)/Grant(s): NAG8-973; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

Frontal polymerization systems, with their inherent large thermal and compositional gradients, are greatly affected by buoyancy-driven convection. Sounding rocket experiments allowed the preparation of benchmark materials and demonstrated that methods to suppress the Rayleigh-Taylor instability in ground-based research did not significantly affect the molecular weight of the polymer. Experiments under weightlessness show clearly that bubbles produced during the reaction interact very differently than under 1 g.
Derived from text
Microgravity; Gravitational Effects; Polymerization; Reaction Kinetics; Space Processing; Bubbles

19990040332 Clarkson Univ., International Center for Gravity Materials Science and Applications, Potsdam, NY USA
Improved Crystal Quality by Detached Solidification in Microgravity
Regel, Liya L., Clarkson Univ., USA; Wilcox, William R., Clarkson Univ., USA; NASA Microgravity Materials Science Conference; February 1999, pp. 533-539; In English; See also 19990040241
Contract(s)/Grant(s): NAG8-1063; NAG8-1482; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

Directional solidification in microgravity has often led to ingots that grew with little or no contact with the ampoule wall. When this occurred, crystallographic perfection was usually greatly improved -- often by several orders of magnitude. Unfortunately, until recently the true mechanisms underlying detached solidification were unknown. As a consequence, flight experiments yielded erratic results. Within the past four years, we have developed a new theoretical model that explains many of the flight results. This model gives rise to predictions of the conditions required to yield detached solidification, both in microgravity and on earth. A discussion of models of detachment, the meniscus models and results of theoretical modeling, and future plans are presented.
Derived from text
Microgravity; Gravitational Effects; Mathematical Models; Ingots; Directional Solidification (Crystals); Crystal Structure; Crystal Surfaces; Crystal Growth

19990040333 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA USA
Thermophysical Property Measurements of Molten Semiconductors in 1-g and Reduced-g Condition
Rhim, Won-Kyu, Jet Propulsion Lab., California Inst. of Tech., USA; NASA Microgravity Materials Science Conference; February 1999, pp. 541-546; In English; See also 19990040241; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

Understanding and controlling the formation kinetics of varieties of crystal imperfections such as point defects, non uniform distribution of doping atoms, and impurity atoms in growing crystals are very important. Theoretical (numerical) modeling of the crystal growth process is an essential step to achieving these objectives. In order to obtain reliable modeling results, input parameters, i.e. various thermophysical parameters, must be accurate. The importance of accurate thermophysical properties of semiconductors in crystal growth cannot be overly emphasized. The total hemispherical emissivity, for instance, has a dramatic impact on the thermal environment. It determines the radiative emission from the surface of the melt which determines to a large extent the profile of the solidified crystal. In order to understand the convection and the turbulence in a melt, viscosity becomes an important parameter. The liquid surface tension determines the shape of the liquid-atmosphere interface near the solid-liquid-atmosphere triple point. Currently used values for these parameters are rather inaccurate, and this program intends to provide more reliable measurements of these thermophysical properties. Thus, the objective of this program is in the accurate measurements of various thermophysical properties which can be reliably used in the modeling of various crystal growth processes. In this program, thermophysical properties of molten semiconductors, such as Si, Ge, Si-Ge, and InSb will be measured as a function of temperature using the High Temperature Electrostatic Levitator at JPL. Each material will be doped by different kinds of impurities at various doping levels. Thermophysical properties which will be measured include: density, thermal expansion coefficient, surface tension, viscosity, specific heat, hemispherical total emissivity, and perhaps electrical and thermal conductivities. Many molten semiconductors are chemically reactive with crucibles. As a result, these dispersed impurities in the melts tend to substantially modify the properties of pure semiconductors. Sample levitation done in a vacuum clearly helps maintain the sample purity. However, in the 1-g environment, all gravity caused effects such as convection, sedimentation and buoyancy are still present in the sample. In addition, large forces needed to levitate a sample in the presence of the gravity can cause additional flows in the melt. The use of the High Temperature Electrostatic Levitator (HTESL) for the present research is a recent development and little

is known about the flows induced by the electrostatic forces. In this ground base program, we will define the limits of HTESL technology as various thermophysical properties of molten semiconductors are measured.
Derived from text
Gravitational Effects; Crystal Growth; Crystal Defects; Thermophysical Properties; Melts (Crystal Growth); Semiconductors (Materials); Doped Crystals; Levitation Melting

19990040336 NASA Marshall Space Flight Center, Huntsville, AL USA
Containerless, Low-Gravity Undercooling of Ti-Ce Alloys in the MSFC Drop Tube
Robinson, M. B., NASA Marshall Space Flight Center, USA; Rathz, T. J., Alabama Univ., USA; Li, D., National Academy of Sciences - National Research Council, USA; Williams, G., Alabama Univ., USA; Workman, G., Alabama Univ., USA; NASA Microgravity Materials Science Conference; February 1999, pp. 555-560; In English; See also 19990040241; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

Previous tests of the classical nucleation theory as applied to liquid-liquid gap miscibility systems found a discrepancy between experiment and theory in the ability to undercool one of the liquids before the L1-L2 separation occurs. to model the initial separation process in a two-phase liquid mixture, different theoretical approaches, such as free-energy gradient and density gradient theories, have been put forth. If there is a large enough interaction between the critical liquid and the crucible, both models predict a wetting temperature (T(sub w)) above which the minority liquid perfectly wets and layers the crucible interface, but only on one side of the immiscibility dome. Materials with compositions on the other side of the dome will have simple surface adsorption by the minority liquid before bulk separation occurs when the coexistence (i.e., binoidal) line in reached. If the interaction between the critical liquid and the crucible were to decrease, T(sub w) would increase, eventually approaching the critical consolute temperature (T(sub cc)). If this situation occurs, then there could be large regions of the miscibility gap where non-perfect wetting conditions prevail resulting in droplets of L1 liquid at the surface having a non-zero contact angle. The resulting bulk structure will then depend on what happens on the surface and the subsequent processing conditions. In the past several decades, many experiments in space have been performed on liquid metal binary immiscible systems for the purpose of determining the effects that different crucibles may have on the wetting and separation process of the liquids. Potard performed experiments that showed different crucible materials could cause the majority phase to preferentially wet the container and thus produce a dispersed microstructure of the minority phase. Several other studies have been performed on immiscibles in a semi-container environment using an emulsion technique. Only one previous study was performed using completely containerless processing of immiscible metals and the results of that investigation are similar to some of the emulsion studies. In all the studies, surface wetting was attributed as the cause for the similar microstructures or the asymmetry in the ability to undercool the liquid below the binoidal on one side of the immiscibility dome. by removing the container completely from the separation process, it was proposed that the loss of the crucible/liquid interaction would produce a large shift in T(sub w) and thus change the wetting characteristics at the surface. by investigating various compositions across the miscibility gap, a change in the type and amount of liquid wetting at the surface of a containerless droplet should change the surface nucleating behavior of the droplet - whether it be the liquid-liquid wetting or the liquid-to-solid transition. Undercooling of the liquid into the metastable region should produce significant differences in the separation process and the microstructure upon solidification. In this study, we attempt to measure these transitions by monitoring the temperature of the sample by optical pyrometry. Microstructural analysis will be made to correlate with the degree of undercooling and the separation mechanisms involved.
Derived from text
Containerless Melts; Microgravity; Supercooling; Nucleation; Miscibility Gap; Wetting; Microstructure; Temperature Measurement; Solidification; Drops (Liquids); Liquid Metals; Liquid Surfaces; Gravitational Effects

19990040338 Case Western Reserve Univ., Dept. of Physics, Cleveland, OH USA
Paramagnetic Liquid Bridge in a Gravity-Compensating Magnetic Field
Mahajan, Milind P., Case Western Reserve Univ., USA; Tsige, Mesfin, Case Western Reserve Univ., USA; Taylor, P. L., Case Western Reserve Univ., USA; Rosenblatt, Charles, Case Western Reserve Univ., USA; NASA Microgravity Materials Science Conference; February 1999, pp. 563-568; Repr. from Physics of Fluids (American Inst. of Physics), 1998; In English; See also 19990040241
Contract(s)/Grant(s): NAG8-1270; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

Magnetic levitation was used to stabilize cylindrical columns of a paramagnetic liquid in air between two solid supports. The maximum achievable length to diameter ratio R(sub max) was approx. (3.10 +/- 0.07), very close to the Rayleigh-Plateau limit of pi. For smaller R, the stability of the column was measured as a function of the Bond number, which could be continuously varied by adjusting the strength of the magnetic field. Liquid Bridges supported by two solid surfaces have been attracting scientific attention since the time of Rayleigh and Plateau. For a cylindrical Bridge of length L and diameter d, it was shown theoretically that in

zero gravity the maximum slenderness ratio R (identically = L/d) is pi. The stability and ultimate collapse of such Bridges is of interest because of their importance in a number of industrial processes and their potential for low gravity applications. In the presence of gravity, however, the cylindrical shape of an axisymmetric Bridge tends to deform, limiting its stability and decreasing the maximum achievable value of R. Theoretical studies have discussed the stability and possible shapes of axisymmetric Bridges. Experiments typically are performed in either a Plateau tank, in which the Bridge is surrounded by a density-matched immiscible fluid, or in a space-borne microgravity environment. It has been shown, for example, that the stability limit R can be pushed beyond pi by using flow stabilization, by acoustic radiation pressure, or by forming columns in the presence of an axial electric field. In this work, magnetic levitation was used to simulate a low gravity environment and create quasi-cylindrical liquid columns in air. Use of a magnetic field permits us to continuously vary the Bond number B identically equal to (g)(rho)d(exp 2)/4(sigma), where g is the gravitational acceleration, rho is the density of the liquid, and sigma is the surface tension of the liquid in air. The dimensionless Bond number represents the relative importance of external forces acting on the liquid column to those due to surface tension. Our central result is that in a large magnetic field gradient we could create and stabilize columns of mixtures of water and paramagnetic manganese chloride tetrahydrate (MnCl2.4H2O), achieving a length to diameter ratio very close to pi.
Derived from text
Paramagnetism; Liquid Bridges; Magnetic Fields; Magnetic Suspension

19990040339 Worcester Polytechnic Inst., Mechanical Engineering Dept., MA USA
Modeling of Macroscopic/Microscopic Transport and Growth Phenomena in Zeolite Crystal Solutions Under Microgravity Conditions
Gatsonis, Nikos A., Worcester Polytechnic Inst., USA; Alexandrou, Andreas, Worcester Polytechnic Inst., USA; Shi, Hui, Worcester Polytechnic Inst., USA; Ongewe, Bernard, Worcester Polytechnic Inst., USA; Sacco, Albert, Jr., Northeastern Univ., USA; NASA Microgravity Materials Science Conference; February 1999, pp. 569-574; In English; See also 19990040241
Contract(s)/Grant(s): NAG8-1255; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

Crystals grown from liquid solutions have important industrial applications. Zeolites, for instance, a class of crystalline aluminosilicate materials, form the backbone of the chemical process industry worldwide, as they are used as adsorbents and catalysts. Many of the phenomena associated with crystal growth processes are not well understood due to complex microscopic and macroscopic interactions. Microgravity could help elucidate these phenomena and allow the control of defect locations, concentration, as well as size of crystals. Microgravity in an orbiting spacecraft could help isolate the possible effects of natural convection (which affects defect formation) and minimize sedimentation. In addition, crystals will stay essentially suspended in the nutrient pool under a diffusion-limited growth condition. This is expected to promote larger crystals by allowing a longer residence time in a high-concentration nutrient field. Among other factors, the crystal size distribution depends on the nucleation rate and crystallization. These two are also related to the ”gel” polymerization/depolymerization rate. Macroscopic bulk mass and flow transport and especially gravity, force the crystals down to the bottom of the reactor, thus forming a sedimentation layer. In this layer, the growth rate of the crystals slows down as crystals compete for a limited amount of nutrients. The macroscopic transport phenomena under certain conditions can, however, enhance the nutrient supply and therefore, accelerate crystal growth. Several zeolite experiments have been performed in space with mixed results. The results from our laboratory have indicated an enhancement in size of 30 to 70 percent compared to the best ground based controls, and a reduction of lattice defects in many of the space grown crystals. Such experiments are difficult to interpret, and cannot be easily used to derive empirical or other laws since many physical parameters are simultaneously involved in the process. At the same time, however, there is increased urgency to develop such an understanding in order to more accurately quantify the process. In order to better understand the results obtained from our prior space experiments, and design future experiments, a detailed fluid dynamic model simulating the crystal growth mechanism is required. This will not only add to the fundamental knowledge on the crystallization of zeolites, but also be useful in predicting the limits of size and growth of these important industrial materials. Our objective is to develop macro/microscopic theoretical and computational models to study the effect of transport phenomena in the growth of crystals grown in solutions. Our effort has concentrated so far in the development of separate macroscopic and microscopic models. The major highlights of our accomplishments are described.
Derived from text
Mathematical Models; Crystal Growth; Zeolites; Microgravity; Spaceborne Experiments; Gravitational Effects; Liquid-Solid Interfaces; Dynamic Models; Transport Properties

19990040342 Harvard Univ., Div. of Engineering and Applied Sciences, CamBridge, MA USA
Test of Dendrite Growth Theory and Nucleation of Polytetrahedral Phases From the Melt
Aziz, Michael J., Harvard Univ., USA; Spaepen, Frans, Harvard Univ., USA; NASA Microgravity Materials Science Conference; February 1999, pp. 589-594; In English; See also 19990040241; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

Our work on Kinetics of Nucleation and Growth from Undercooled Melts falls in two general categories, based on the experimental techniques that are being employed. In the first category, laser heating and thin film diagnostic techniques are used to study crystal growth and liquid diffusion. In the second category, fluxing, a drop tube or vacuum processing are used to achieve undercooling of fairly large melt quantities for the study of crystal nucleation and glass formation. In this paper, we present a recent example from each category: (1) a parameter-free test of dendrite growth theory by a combination of levitation (in collaboration with D.M. Herlach's group at DLR) and pulsed-laser melting techniques; and (2) an analysis of the nucleation of polytetrahedral crystals (Laves phase) from the melt during solidification in a gas-filled drop tube.
Derived from text
Crystal Growth; Kinetics; Laser Heating; Laves Phases; Melts (Crystal Growth); Nucleation; Solidification; Dendritic Crystals

19990040348 Florida Univ., Dept. of Chemistry, Gainesville, FL USA
The Features of Self-Assembling Organic Bilayers Important to the Formation of Anisotropic Inorganic Materials in Microgravity Conditions
Talham, Daniel R., Florida Univ., USA; Adair, James H., Pennsylvania State Univ., USA; NASA Microgravity Materials Science Conference; February 1999, pp. 623-628; In English; See also 19990040241
Contract(s)/Grant(s): NAG8-1244; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

There is a growing need for inorganic anisotropic particles in a variety of materials science applications. Structural, optical, and electrical properties can be greatly augmented by the fabrication of composite materials with anisotropic microstructures or with anisotropic particles uniformly dispersed in an isotropic matrix. Examples include structural composites, magnetic and optical recording media, photographic film, certain metal and ceramic alloys, and display technologies including flat panel displays. While considerable progress has been made toward developing an understanding of the synthesis of powders composed of monodispersed, spherical particles, these efforts have not been transferred to the synthesis of anisotropic nanoparticles. The major objective of the program is to develop a fundamental understanding of the growth of anisotropic particles at organic templates, with emphasis on the chemical and structural aspects of layered organic assemblies that contribute to the formation of anisotropic inorganic particles.
Derived from text
Anisotropy; Microgravity; Optical Materials; Templates; Layers; Inorganic Materials; Organic Materials

19990040351 NASA Marshall Space Flight Center, Huntsville, AL USA
Investigation of the Influence of Microgravity on Transport Mechanisms in a Virtual Spaceflight Chamber: A Ground Based Program
Trolinger, James D., MetroLaser, USA; Rangel, Roger, California Univ., USA; Witherow, William, NASA Marshall Space Flight Center, USA; Rogers, Jan, NASA Marshall Space Flight Center, USA; Lal, Ravindra B., Alabama A & M Univ., USA; NASA Microgravity Materials Science Conference; February 1999, pp. 641-646; In English; See also 19990040241; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

In January 1992, the IML-1 FES experiment produced a set of classic experimental data and a 40 hour holographic "movie" of an ensemble of spheres in a fluid in microgravity. Because the data are in the form of holograms, we can study the three-dimensional distribution of particles with unprecedented detail by a variety of methods and for a wide variety of interests. The possession of the holographic movie is tantamount to having a complex experiment in space while working in an easily accessible laboratory on earth. The movie contains a vast amount of useful data, including residual g, g-jitter, convection and transport data, and particle fluid interaction data. The information content in the movie is so great that we have scarcely begun to tap into the data that is actually available in the more than 1000 holograms, each containing as much as 1000 megabytes of information. This ground-based project is exploiting this data and the concept of holographic storage of spaceflight data to provide an understanding of the effects of microgravity in materials processing. This paper provides the foundation, objectives, and status of the ground based project. The primary objective of this project is to advance the understanding of microgravity effects on crystal growth, convection in materials processing in the space environment, and complex transport phenomena at low Reynolds numbers. This objective is being achieved both experimentally and theoretically. Experiments are making use of existing holographic data recorded during the IML- I spaceflight. A parallel theoretical effort is providing the models for understanding the particle fields and their physics in the microgravity environment.
Derived from text
Microgravity; Crystal Growth; Convection; Space Processing; Transport Properties; Spaceborne Experiments; Microgravity Applications; Holography

19990040352 NASA Marshall Space Flight Center, Huntsville, AL USA

Investigation of the Influence of Microgravity on Transport Mechanism in a Virtual Spaceflight Chamber: A Flight Definition Program

Trolinger, James D., MetroLaser, USA; Rangel, Roger, California Univ., USA; Witherow, William, NASA Marshall Space Flight Center, USA; Rogers, Jan, NASA Marshall Space Flight Center, USA; Lal, Ravindra B., Alabama A & M Univ., USA; NASA Microgravity Materials Science Conference; February 1999, pp. 647-653; In English; See also 19990040241; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

A need exists for understanding precisely how particles move and interact in a fluid in the absence of gravity. Such understanding is required, for example, for modeling and predicting crystal growth in space where crystals grow from solution around nucleation sites as well as for any study of particles or bubbles in liquids or in experiments where particles are used as tracers for mapping microconvection. We have produced an exact solution to the general equation of motion of particles at extremely low Reynolds number in microgravity that covers a wide range of interesting conditions. We have also developed diagnostic tools and experimental techniques to test the validity of the general equation . This program, which started in May, 1998, will produce the flight definition for an experiment in a microgravity environment of space to validate the theoretical model. We will design an experiment with the help of the theoretical model that is optimized for testing the model, measuring g, g-jitter, and other microgravity phenomena. This paper describes the goals, rational, and approach for the flight definition program. The first objective of this research is to understand the physics of particle interactions with fluids and other particles in low Reynolds number flows in microgravity. Secondary objectives are to (1) observe and quantify g-jitter effects and microconvection on particles in fluids, (2) validate an exact solution to the general equation of motion of a particle in a fluid, and (3) to characterize the ability of isolation tables to isolate experiments containing particle in liquids. The objectives will be achieved by recording a large number of holograms of particle fields in microgravity under controlled conditions, extracting the precise three-dimensional position of all of the particles as a function of time and examining the effects of all parameters on the motion of the particles. The feasibility for achieving these results has already been established in the ongoing ground-based NRA, which led to the ”virtual spaceflight chamber” concept.

Derived from text

Microgravity; Space Flight; Spaceborne Experiments; Particle Interactions; Fluid Flow; Convection; Vibration Effects; Equations of Motion; Microgravity Applications; Space Processing

19990040355 Containerless Research, Inc., Evanston, IL USA

Process-Property-Structure Relationships in Complex Oxide Melts

Weber, Richard, Containerless Research, Inc., USA; Nordine, Paul, Containerless Research, Inc., USA; NASA Microgravity Materials Science Conference; February 1999, pp. 667-672; In English; See also 19990040241; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

Investigation of process-property-structure relationships in high temperature liquids is essential to a scientific understanding of the liquid state and technological advances in liquid-phase processing. This research is concerned with the effects of processing variables on the behavior and properties of molten oxides. It uses containerless experimental methods to eliminate container-derived contamination, allow equilibration with controlled p(O(sub 2)) atmospheres, and avoid heterogeneous nucleation by container walls to access highly non-equilibrium liquids. Research during the first two years (June 1996-June 1998) included investigation of binary alumina-silica (Al2O3-SiO2) and alumina-yttria (Al2O-Y2O3) materials. Strong emphasis has been placed on investigation of the alumina-yttria compositions because they form melts which display an anomalous increase in viscosity when they are undercooled. The alumina-yttria system is a promising candidate for low gravity experiments to measure the melt viscosity, investigate liquid phase transitions, and investigate the onset of increased viscosity in the liquid. Low gravity experiments are being developed in a separate Flight Definition project. Accomplishments to date which are described in detail in this report were to: (1) Investigate liquid-phase processing, undercooling, and solidification of binary alumina-silica and alumina-yttria materials as a function of composition, ambient p(O(sub 2)), and thermal history; (2) Investigate the anomalous increase in the viscosity observed in deeply undercooled melts; (3) Measure the enthalpy of solution of compounds formed by containerless cooling of melts and determine the enthalpy of vitrification of YAG; (4) Characterize processed materials using optical and scanning electron microscopy and X ray diffraction analysis; (5) Develop collaborative research activities in the area of processing oxides; (6) Publish and present results.

Derived from text

Aluminum Oxides; Silicon Dioxide; Yttrium Oxides; Containerless Melts; Solidification; Supercooling; Liquid Phases; Metastable State

19990040356 Containerless Research, Inc., Evanston, IL USA

Microgravity Studies of Liquid-Liquid Phase Transitions in Undercooled Alumina-Yttria Melts

Weber, Richard, Containerless Research, Inc., USA; Nordine, Paul, Containerless Research, Inc., USA; NASA Microgravity Materials Science Conference; February 1999, pp. 673-678; In English; See also 19990040241; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

The scientific objective of this research is to increase the fundamental knowledge base for liquid-phase processing of technologically important oxide materials. The experimental objective is to define precise conditions and hardware requirements for microgravity flight experiments to test and expand the experimental hypotheses that: (1) Liquid phase transitions can occur in undercooled melts by a diffusionless transformation; and (2) Onset of the liquid phase transition is accompanied by a large change in the temperature dependence of viscosity. Recent experiments on undercooled YAG (Y3Al5O12)-composition liquid demonstrated a large departure from an Arrhenian temperature dependence of viscosity. Fibers were pulled from melts undercooled by ca. 600 deg indicating that the viscosity is on the order of 100 Pa.s (1000 Poise) at 1600 K. This value of viscosity is 500 times greater than that obtained by extrapolation of data for temperatures above the melting point of YAG. YAG is known to be a very ”fragile” glass former and the fiber pulling experiments indicate that the onset of the highly non-Arrhenian viscosity-temperature relationship occurs at a temperature considerably below the equilibrium melting point of YAG. Experimental results on undercooled alumina-yttria melts containing 24-30 mole % yttrium oxide suggest that a liquid phase transition occurs at rates inconsistent with diffusion limited separation processes. This raises the possibility that a congruent liquid phase transition can occur in YAG composition liquid. Molecular dynamics simulations on undercooled water also show coexistence of two liquids with the same composition but different density in the undercooled state. This result lends further support to the concept that polymorphic phase transitions can occur in metastable liquids. The idea that changes in melt structure and bonding associated with liquid phase transitions in molten oxides result in large changes in melt viscosity is the principal subject of this investigation.

Derived from text

Aluminum Oxides; Yttrium Oxides; Phase Transformations; Melts (Crystal Growth); Gravitational Effects; Microgravity; Yttrium-Aluminum Garnet; Supercooling; Viscosity; Diffusion

19990040360 Clarkson Univ., Potsdam, NY USA

Use of Microgravity to Control the Microstructure of Eutectics

Wilcox, William R., Clarkson Univ., USA; Regel, Liya L., Clarkson Univ., USA; Smith, Reginald W., Queens Univ., Canada; NASA Microgravity Materials Science Conference; February 1999, pp. 689-694; In English; See also 19990040241

Contract(s)/Grant(s): NAG8-1266; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

The long term goal of this project is to be able to control the microstructure of directionally solidified eutectic alloys, through an improved understanding of the influence of convection. Prior experimental results on the influence of microgravity on the microstructure of fibrous eutectics have been contradictory. Theoretical work at Clarkson University showed that buoyancy-driven convection in the vertical Bridgman configuration is not vigorous enough to alter the concentration field in the melt sufficiently to cause a measurable change in microstructure when the eutectic grows at minimum supercooling. Currently, there are four other hypotheses that might explain the observed changes in microstructure of fibrous eutectics caused by convection: (1) Disturbance of the concentration boundary layer arising from an off-eutectic melt composition and growth at the extremum; (2) Disturbance of the concentration boundary layer of a habit-modifying impurity; (3) Disturbance of the concentration boundary layer arising from an off-eutectic interfacial composition due to non-extremum growth; and (4) A fluctuating freezing rate combined with differences in the kinetics of fiber termination and fiber formation. We favor the last of these hypotheses. Thus, the primary objective of the present grant is to determine experimentally and theoretically the influence of a periodically varying freezing rate on eutectic solidification. A secondary objective is to determine the influence of convection on the microstructure of at least one other eutectic alloy that might be suitable for flight experiments.

Derived from text

Microgravity; Gravitational Effects; Eutectic Alloys; Convection; Solidification; Melts (Crystal Growth); Freezing

19990040624 NASA Lewis Research Center, Cleveland, OH USA

Ground-Based Gas-Liquid Flow Research in Microgravity Conditions: State of Knowledge

McQuillen, J., NASA Lewis Research Center, USA; Colin, C., Institut de Mecanique des Fluides de Toulouse, France; Fabre, J., Institut de Mecanique des Fluides de Toulouse, France; Aug. 06, 1997; 58p; In English

Contract(s)/Grant(s): RTOP 963-25-0H; No Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

During the last decade, ground-based microgravity facilities have been utilized in order to obtain predictions for spacecraft system designers and further the fundamental understanding of two-phase flow. Although flow regime, pressure drop and heat transfer coefficient data has been obtained for straight tubes and a limited number of fittings, measurements of the void fraction,

film thickness, wall shear stress, local velocity and void information are also required in order to develop general mechanistic models that can be utilized to ascertain the effects of fluid properties, tube geometry and acceleration levels. A review of this research is presented and includes both empirical data and mechanistic models of the flow behavior.
Author
Liquid-Gas Mixtures; Microgravity; Pressure Drop; Heat Transfer Coefficients; Gravitational Effects

31
ENGINEERING (GENERAL)

Includes vacuum technology; control engineering; display engineering; cryogenics; and fire prevention.

19990039135 Department of Energy, Office of Financial Management and Controller, Washington, DC USA
Linkage design effect on the reliability of surface micromachined microengines driving a load
Tanner, D. M., Department of Energy, USA; Peterson, K. A., Department of Energy, USA; Irwin, L. W., Department of Energy, USA; Tangyunyong, P., Department of Energy, USA; Miller, W. M., Department of Energy, USA; Dec. 31, 1998; 12p; In English
Report No.(s): DE98-007173; SAND-98-1681C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The reliability of microengines is a function of the design of the mechanical linkage used to connect the electrostatic actuator to the drive. The authors have completed a series of reliability stress tests on surface micromachined microengines driving an inertial load. In these experiments, the authors used microengines that had pin mechanisms with guides connecting the drive arms to the electrostatic actuators. Comparing this data to previous results using flexure linkages revealed that the pin linkage design was less reliable. The devices were stressed to failure at eight frequencies, both above and below the measured resonance frequency of the microengine. Significant amounts of wear debris were observed both around the hub and pin joint of the drive gear. Additionally, wear tracks were observed in the area where the moving shuttle rubbed against the guides of the pin linkage. At each frequency, they analyzed the statistical data yielding a lifetime (t(sub 50)) for median cycles to failure and sigma, the shape parameter of the distribution. A model was developed to describe the failure data based on fundamental wear mechanisms and forces exhibited in mechanical resonant systems. The comparison to the model will be discussed.
NTIS
Miniaturization; Actuators; Engines; Reliability; Transmissions (Machine Elements)

19990039210 Department of Energy, Office of Financial Management and Controller, Washington, DC USA
Overview of reliability assessment and control for design of civil engineering structures
Field, R. V., Department of Energy, USA; Grigoriadis, K. M., Department of Energy, USA; Bergman, L. A., Department of Energy, USA; Skelton, R. E., Department of Energy, USA; Jun. 30, 1998; 10p; In English; 2nd; Structural Control, USA
Report No.(s): DE98-005896; SAND-98-1392C; CONF-980667; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Random variations, whether they occur in the input signal or the system parameters, are phenomena that occur in nearly all engineering systems of interest. As a result, nondeterministic modeling techniques must somehow account for these variations to ensure validity of the solution. As might be expected, this is a difficult proposition and the focus of many current research efforts. Controlling seismically excited structures is one pertinent application of nondeterministic analysis and is the subject of the work presented herein. This overview paper is organized into two sections. First, techniques to assess system reliability, in a context familiar to civil engineers, are discussed. Second, and as a consequence of the first, active control methods that ensure good performance in this random environment are presented. It is the hope of the authors that these discussions will ignite further interest in the area of reliability assessment and design of controlled civil engineering structures.
NTIS
Systems Analysis; Reliability; Design Analysis; Structural Engineering; Active Control; Seismology

19990039581 Department of Energy, Washington, DC USA
Risk assessment and integrity in system design
Berg, R. S., Department of Energy, USA; Winter, V., Department of Energy, USA; Mar. 31, 1998; 8p; In English; Engineering of Complex Computer Systems, USA
Report No.(s): DE98-005717; SAND-98-0707C; CONF-980809; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

All systems, regardless of how carefully they have been constructed, suffer failures. This paper focuses on developing a formal understanding of failure with respect to system implementations. Furthermore, the authors would like the system design pro-

cess to be able to leverage off of this understanding. It is important to deal with failures in a system context, rather than a priori limiting the solution to a particular technology, such as software alone. Their approach is limited to the class of systems that can be modeled by hybrid finite state machines (HFSMs) as described in Winter. The purpose of this paper is to lay out a process, or framework that can aid in identification and characterization of techniques for dealing with the different types of system threats. This framework leads naturally to a taxonomy of technologies and strategies for dealing with the various types of threats. In this process technologies are used to identify a priority list of technical capabilities for dealing with threats. The technologies are prioritized according to their analyzability and predictability. Strategies are then used to identify specific implementations that are best suited to dealing with the threat.
NTIS
Failure; Systems Analysis; Systems Engineering; Priorities; Predictions; Assessments

19990040197 NASA Marshall Space Flight Center, Huntsville, AL USA
Dynamic Testing of an Inflatable Structure Under Thermal Vacuum Conditions
Engberg, Robert, NASA Marshall Space Flight Center, USA; Lassiter, John, NASA Marshall Space Flight Center, USA; 1998; In English
Report No.(s): AIAA Paper 99-1519; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

The Marshall Space Flight Center's Space Transportation Programs Office is responsible for the development and demonstration of advanced launch vehicle and propulsion technologies. One of these advanced propulsion concepts being pursued is solar thermal propulsion. This concept employs a concentrated beam of sunlight to heat a working fluid within a solar thermal engine. Expansion of the fluid would provide thrust at an increased specific impulse. One way to concentrate the sun's light to a specific point in the engine cavity is to use a fresnel lens that is supported by an inflatable structure. Such propulsion systems could provide an inexpensive way of transferring and maintaining satellites to upper stage orbit trajectories. This paper describes the test hardware, procedures, and non-contacting measurement methodologies used to determine the modal characteristics of an inflatable concentrator under the thermal-vacuum conditions of space. These characteristics were necessary to identify for validation of a finite element model to be used for developing the spacecraft's pointing and control system.
Author
Propulsion System Configurations; Inflatable Structures; Vacuum; Solar Thermal Propulsion; Dynamic Tests; Concentrators

19990040200 NASA Marshall Space Flight Center, Huntsville, AL USA
Analytical and Experimental Investigation of the Dynamics of Polyimide Inflatable Cylinders
Slade, Kara N., Duke Univ., USA; Tinker, Michael L., NASA Marshall Space Flight Center, USA; 1999; In English; 40th; Structures, Structural Dynamics and Materials, 12-15 Apr. 1999, Saint Louis, MO, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Report No.(s): AIAA Paper 99-1518; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

An investigation of the dynamics and load-deflection behavior of an inflatable cylindrical strut constructed of Kapton polyimide film is described. Such a structure has considerable practical application and potential as a component of inflatable solar concentrator assemblies, antenna structures, and space power systems. Non-rigidized inflatable structures for potential space applications are adaptive systems in that a regulator and relief valve would be required to maintain pressure within design limits during the full range of orbital conditions. Further, the polyimide film material used for construction of the inflatable (and the film-to-pressurized-air interaction) is highly nonlinear, with modulus varying as a function of frequency, temperature, and level of excitation. In view of these characteristics, a series of tests and analytical modeling efforts are described for determining the inflatable cylinder's response at various pressures and loading conditions. A number of interesting phenomena have been discovered during this investigation and related studies. It has been found that the inflatable cylinder exhibits (1) decreasing effective modulus of elasticity as function of frequency in free-free and cantilevered configurations, (2) wrinkling near a cantilever end in response to increased static tip load, and (3) bifurcation phenomena or resonant peak splitting with increased dynamic force amplitude.
Author
Polyimides; Inflatable Structures; Cylindrical Bodies; Concentrators; Antenna Components

19990040464 NASA Goddard Space Flight Center, Greenbelt, MD USA
20th Space Simulation Conference: The Changing Testing Paradigm
Stecher, Joseph L., III, Compiler, NASA Goddard Space Flight Center, USA; February 1999; 366p; In English; 20th, 27-29 Oct. 1998, Annapolis, MD, USA; Sponsored by NASA, USA; See also 19990040465 through 19990040495
Report No.(s): NASA/CP-1999-208598; Rept-98A01761; NAS 1.55:208598; No Copyright; Avail: CASI; A16, Hardcopy; A03, Microfiche

The Institute of Environmental Sciences and Technology's Twentieth Space Simulation Conference, "The Changing Testing Paradigm" provided participants with a forum to acquire and exchange information on the state-of-the-art in space simulation, test technology, atomic oxygen, program/system testing, dynamics testing, contamination, and materials. The papers presented at this conference and the resulting discussions carried out the conference theme "The Changing Testing Paradigm."
Author
Conferences; Dynamic Tests; Simulation; Systems Simulation; Aerospace Environments; Low Earth Orbits; Thermal Simulation; Space Environment Simulation

19990040689 Virginia Transportation Research Council, Charlottesville, VA USA
Field Evaluation of Corrosion Inhibitors for Concrete: Interim Report 1. Evaluation of Exposure Slabs Repaired with Corrosion Inhibitors
Sprinkel, M.; Ozyildirim, C.; Dec. 1998; 60p; In English
Report No.(s): PB99-130569; VTRC-99-IR1; Copyright; Avail: National Technical Information Service (NTIS), Microfiche
One hundred and fifty-six exposure slabs have been constructed with and without a variety of combinations of corrosion inhibiting admixtures and topically applied inhibitors. to accelerate corrosion one hundred and thirty-six of the slabs were constructed with concrete that surrounded the top mat of reinforcement with chloride contents of 3, 6, 10, and 15 lb/cubic yard (1.8, 3.5, 5.9, and 8.9 kg/cu m). This paper presents the results from measurements made on the slabs in May 1998 after approximately 1 year of exposure. The measurements show that as the chloride ion content in the slabs increases, the macrocell current, macrocell potential, half-cell potential, and rate of corrosion increase and the resistance decreases.
NTIS
Concretes; Corrosion Prevention; Bridges (Structures)

19990040795 Los Alamos National Lab., NM USA
Thermodynamics and electrodynamics of unusual narrow-gap semiconductors
Migliori, A.; Darling, T. W.; Trugman, S. A.; Freibert, F.; Moshopoulou, E.; Dec. 31, 1998; 10p; In English
Report No.(s): DE99-001119; LA-UR-98-1885; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
The project was directed toward exploring the Ettingshausen effect, which is the direct extension of the familiar Peltier-effect refrigerator (the process used in popular coolers that run off automotive electrical power) in which a magnetic field is used to enhance refrigeration effects at temperatures well below room temperature. Such refrigeration processes are all-solid-state and are of potentially great commercial importance, but essentially no work has been done since the early 1970s. Using modern experimental and theoretical techniques, the authors have advanced the state-of-the-art significantly, laying the groundwork for commercial cryogenic solid-state refrigeration.
NTIS
Thermodynamics; Electrodynamics; Semiconductors (Materials); Cryogenic Cooling

19990040819 National Inst. of Standards and Technology, Building and Fire Research Lab., Gaithersburg, MD USA
Design Parameters for Stack-Mounted Light Extinction Measurement Devices
Putorti, A. D.; Jan. 1999; 42p; In English
Report No.(s): PB99-128928; NISTIR-6215; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
This paper discusses existing methods of light extinction measurement, theoretical aspects of light extinction, and measurement device features that are necessary for the accurate and precise measurement of extinction. The topics are discussed in the context of smoke mass concentration and smoke yield determination for fire experiments conducted in the furniture calorimeter at the NIST Large Fire Research Facility and in other similar fire research facilities.
NTIS
Calorimeters; Temperature Measurement; Fires

19990040891 Royal Melbourne Inst. of Tech., Sir Lawrence Wackett Centre for Aerospace Design Technology, Australia
Wing in Ground Effect Craft Review
Halloran, Michael, Royal Melbourne Inst. of Tech., Australia; OMeara, Sean, Royal Melbourne Inst. of Tech., Australia; February 1999; In English
Report No.(s): RMIT-CR-9802; DSTO-GD-0201; DODA-AR-010-831; Copyright; Avail: Issuing Activity (DSTO Aeronautical and Maritime Research Lab., PO Box 4331, Melbourne, Victoria 3001, Australia), Hardcopy, Microfiche
It has long been recognized that flight close to a boundary surface is more aerodynamically efficient than flight in the free-stream. This has led to the design and construction of craft specifically intended to operate close to the ground and fly 'in ground

effect'. A great range of Wing in Ground effect craft (WIGS) have been manufactured ranging from 2 seat recreational vehicles to 500 tonn warcraft. Despite this WIGs have never enjoyed great commercial or military success. The Maritime Platform Division of DSTO commissioned The Sir Lawrence Wackett Centre for Aerospace Design Technology to conduct a design review of WIG craft. This review considers all elements of WIG design and operation, including performance, limitations, control, stability, operational requirements, regulation, manufacture and technological risk. The review highlights the research required to overcome the weaknesses of WIG craft, the advantages that they may offer and the possible uses of WIG craft in the Australian military.
Author
Wings; Ground Effect (Aerodynamics); Design Analysis; Control Stability

19990040939 Electrotechnical Lab., Tsukuba, Japan
Study on Small-Size Vuilleumier Cycle Cryocooler for Space Use
Kawada, Masakuni, Electrotechnical Lab., Japan; Sep. 1997; ISSN 0366-9106; 96p; In Japanese; Original contains color illustrations
Report No.(s): Rept-983; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

Since, recently optical sensor systems incorporated in sophisticated earth observation satellites use Infrared (IR) sensors cooled to cryogenic temperature, small-size cryocoolers with high reliability and long lifetimes are required. The purpose of this study is to develop technologies for the Vuilleumier cycle cryocooler. The Vuilleumier cycle cryocooler is a heat-driven machine patented by Rudolph Vuilleumier in the USA in 1918. This type of cryocooler has the potential advantages of long-time operation, low mechanical vibration, compact and light weight. However, since the Vuilleumier cycle cryocooler incorporates many design parameters, the relationship between these parameters must be clarified for optimizing its design and improving its performance. Therefore, a performance analysis model of the cryocooler was constructed first. by analysis of this model, a prototype cryocooler operable in an atmospheric environment was designed and constructed. The practicality of the proposed design approach was determined by performance and endurance evaluation tests. In the final stage, a cryocooler operable in a vacuum environment, whose structural configuration was optimized, was experimentally fabricated. Overall function and performance tests were conducted using a space chamber built to simulate an actual space environment and the thermal conditions with in the satellite. The possibility of a practical use for space applications of the small-size cryocooler was demonstrated for the first time in Japan, and the foundations of cryocooler technologies have been established. This dissertation consists of seven chapters. Chapter 1. Introduction. Chapter 2. The principle of the cryocooler operation, which is characterized by the use of thermal energy to cyclically pressurize the working helium gas, is described. Chaptr 3. The author clarifies the relationship between operating conditions and cryocooler performance. Chapter 4. The main operation conditions such as charge pressure, hot wall temperature, and rotation speed are varied over a wide range, and the effect of these conditions on the heater input power, cold head temperature with no heat load and cooling performance are studied. Chapter 5. The results of the long-term operation test are described. Chapter 6. The result of the overall performance test, including in - vacuum heat rejection using passive radiator, are presented. Chapter 7. The results obtained in this study are summarized.
Author
Cooling; Cryogenic Temperature; Design Analysis; Fabrication; Helium; Optical Measuring Instruments; Performance Tests; Wall Temperature

19990041097 NASA Langley Research Center, Hampton, VA USA
A Gas-Actuated Projectile Launcher for High-Energy Impact Testing of Structures
Ambur, Damodar R., NASA Langley Research Center, USA; Jaunky, Navin, Old Dominion Univ., USA; Lawson, Robin E., Old Dominion Univ., USA; Knight, Norman F., MRJ Technology Solutions, Inc., USA; Lyle, Karen H., Army Research Lab., USA; 1999; In English; 40th; Structures, Structural Dynamics, and Materials, 12-15 Apr. 1999, Saint Louis, MO, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

A gas-actuated penetration device has been developed for high-energy impact testing of structures. The high-energy impact testing is for experimental simulation of uncontained engine failures. The non-linear transient finite element code LS-DYNA3D has been used in the numerical simulations of a titanium rectangular blade with an aluminum target plate. Threshold velocities for different combinations of pitch and yaw angles of the impactor were obtained for the impactor-target test configuration in the numerical simulations. Complete penetration of the target plate was also simulated numerically. Finally, limited comparison of analytical and experimental results is presented for complete penetration of the target by the impactor.
Author
Launchers; Impact Tests; Fabrication; Engine Failure; Penetration

32
COMMUNICATIONS AND RADAR

Includes radar; land and global communications; communications theory; and optical communications. For related information see also 04 Aircraft Communications and Navigation and 17 Space Communications, Spacecraft Communications, Command and Tracking. For search and rescue see 03 Air Transportation and Safety, and 16 Space Transportation.

19990038384 Federal Aviation Administration, Research and Special Programs Administration, CamBridge, MA USA
Pilot-Controller Communication Errors: An Analysis of Aviation Safety Reporting System (ASRS) Reports ***Final Report, Jul. 1991 - May 1996***
Cardosi, Kim; Falzarano, Paul; Han, Sherwin; Jan. 1999; 37p; In English
Report No.(s): AD-A361542; DOT-VNTSC-FAA-98-4; DOT/FAA/AR-98/17; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The purpose of this study was to identify the factors that contribute to pilot-controller communication errors. Reports submitted to the Aviation Safety Reporting System (ASRS) offer detailed accounts of specific types of errors and a great deal of insight as to why they occur. The communication errors found in this study could be classified into three types: Readback/hearback errors (the pilot reads back the clearance incorrectly and the controller fails to correct the error), the absence of a pilot readback,and Hearback Errors Type II (the controller fails to notice his or her own error in the pilot's correct readback). In the 386 reports analyzed, the most common contributing factors were: similar call signs on the same frequency, pilot expectations (e.g., accepting a clearance that they expected rather than what the controller actually said), and high controller workload. The identified results of these communication errors were (in order of prominence): altitude deviations, loss of standard separation, ATC operational errors, pilots landing on the wrong runway, and runway transgressions. The report concludes with recommendations for reducing the number of communication errors between pilots and controllers.
DTIC
Errors; Aircraft Safety; Pilots (Personnel); Flight Control; Voice Communication

19990039095 Air Force Inst. of Tech., School of Engineering, Wright-Patterson AFB, OH USA
Active Multispectral Band Selection and Reflectance Measurement System
Rennich, Bradley D.; Mar. 01, 1999; 90p; In English
Report No.(s): AD-A361421; AFIT/GEO/ENP/99M-01; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

Due to system design requirements, an active multispectral laser radar system may be limited in the number of spectral bands that can be integrated into the system. to aid in the selection of these bands, a novel multispectral band selection technique is presented based on the cross-correlation of the material class reflectance spectra over a wavelength range of 1 - 5 microns. The algorithm uses directional hemispherical reflectance data from the Nonconventional Exploitation Factors database to select a number of spectral bands for classification purposes. Because the target material spectral reflectance is so important to the performance of an active multispectral system, an experimental monostatic bidirectional reflectance distribution function (BRDF) measurement system is developed and tested. A 1.06 micron Nd:YAG diode pumped laser is frequency shifted to 1.58 - 1.80 microns using a periodically poled lithium niobate nonlinear crystal. This laser provides the continuously tunable source necessary to measure the material BRDF at closely spaced wavelength intervals. A complete error analysis of the system is presented with measurement results from a number of military vehicle paint samples. An extended design is presented which is capable of operating at any wavelength in the 1 - 5 micron range. This design also reduces or removes the error sources observed in the initial experiment.
DTIC
Optical Radar; Bidirectional Reflectance; Multispectral Radar; Spectral Bands; Targets

19990039206 Department of Energy, Office of Energy Research, Washington, DC USA
Image appraisal for 2D and 3D electromagnetic inversion
Alumbaugh, D. L., Department of Energy, USA; Newman, G. A., Department of Energy, USA; Apr. 30, 1998; 7p; In English; Sponsored by Society of Exploration Geophysicists, Japan
Report No.(s): DE98-005761; SAND-98-0995C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Linearized methods are presented for appraising image resolution and parameter accuracy in images generated with two and three dimensional non-linear electromagnetic inversion schemes. When direct matrix inversion is employed, the model resolution and model covariance matrices can be directly calculated. The columns of the model resolution matrix are shown to yield empirical estimates of the horizontal and vertical resolution throughout the imaging region. Plotting the square root of the diagonal of the model covariance matrix yields an estimate of how the estimated data noise maps into parameter error. When the conjugate gradient method is employed rather than a direct inversion technique (for example in 3D inversion), an iterative method can be applied

to statistically estimate the model covariance matrix, as well as a regularization covariance matrix. The latter estimates the error in the inverted results caused by small variations in the regularization parameter. A method for calculating individual columns of the model resolution matrix using the conjugate gradient method is also developed. Examples of the image analysis techniques are provided on a synthetic cross well EM data set.
NTIS
Image Resolution; Nonlinearity; Imaging Techniques; Conjugate Gradient Method; Two Dimensional Models; Three Dimensional Models; Mathematical Models; Electromagnetism

19990039551 Research Inst. of Information Stochastic Systems, Rennes, France
Probabilistic Methods for Multitarget Tracking
Lacdre, Jean-Pierre; Jan. 1999; 166p; In English, 9-10 Nov. 1998, Paris, France
Contract(s)/Grant(s): N00014-99-1-1015
Report No.(s): AD-A361446; No Copyright; Avail: Issuing Activity (Defense Technical Information Center (DTIC)), Microfiche
Compilation of abstracts from the conference entitled "Probabilistic Methods for Multitarget Tracking" held in Paris, France from 9 - 10 November 1998.
DTIC
Conferences; Radar Tracking

19990040412 Matis, Inc., Atlanta, GA USA
Novel Techniques for Solving High Frequency Electromagnetic Scattering Problems on Complete Aircraft ***Final Report, 1 Apr. 1997 - 31 Mar. 1998***
Oliker, Vladimir; Jun. 30, 1998; 10p; In English
Contract(s)/Grant(s): F49620-97-C-0007
Report No.(s): AD-A361223; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche
In this work a method for constructing wave propagation paths on aircraft modeled with nonuniform rational bi-cubic splines has been proposed and investigated. Procedures for dealing with artificial discontinuities due to geometric mis-matches of spline patches have been developed and implemented in numerical codes.
DTIC
Electromagnetic Scattering; Wave Propagation; Discontinuity

19990040416 Logicon Technical Services, Inc., Dayton, OH USA
A Human Factors Evaluation of ESAR/ATR Integration for the Theater Missile Defense (TMD) Automatic Target Recognition (ATR) Rapid Response Targeting Against Mobile Ground Targets (RTM) Program ***Interim Report, 1 Apr. 1997 - 1 May 1998***
Riegler, Joseph T.; Stewart, Robert L.; Fitzhugh, Elisabeth W.; Janson, William P.; Kuperman, Gilbert G.; Jul. 1998; 25p; In English
Contract(s)/Grant(s): F41624-94-D-6000; AF Proj. 7184
Report No.(s): AD-A361260; AFRL-HE-WP-TR-1998-0093; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
This report describes a human factors evaluation of the target prosecution benefits of integrated enhanced synthetic aperture radar (ESAR) and automatic target recognition (ATR) technologies. Workstation operators aboard E-8C Joint Surveillance Target Attack Radar System (JSTARS) aircraft field-tested integrated ATR information and ESAR imagery during performance of mobile missile launcher targeting tasks on a series of demonstration flights. Two methods of data collection were used: post-flight questionnaires collected subjective operator assessments, and a human factors engineer conducted in-flight observation. The evaluative goal was to assess operator acceptance and to establish guidelines for the integration of ATR and ESAR capabilities on the JSTARS. Results included significantly positive ratings for increase in situation awareness, somewhat decreased or unchanged ratings for workload, and no reports of increase in visual fatigue. Three of four operators recommended the incorporation of an integrated ATR/ESAR imagery capability into the JSTARS graphic display. Operators also requested inclusion of ATR numeric confidence ratings and that display of ATR information be optional. Human factors design recommendations cited existing military standards and human factors industry guidelines for improved displays and display interfaces.
DTIC
Synthetic Aperture Radar; Human Factors Engineering; Surveillance Radar; Target Recognition; Display Devices

19990040495 Intespace, Toulouse, France

The MISTRAL Antenna Measurement Compact Range at Intespace

Marce, Jean-Louis, Intespace, France; Meisse, Pascal, Intespace, France; Berge, Remi, Intespace, France; 20th Space Simulation Conference: The Changing Testing Paradigm; February 1999, pp. 355-366; In English; See also 19990040464; No Copyright; Avail: CASI; A03, Hardcopy; A03, Microfiche

Leader in the field of space environment simulation (vibrations, thermal vacuum, acoustics, EMC), INTESPACE company has built a new compact range for antenna measurement called MISTRAL with a view to providing an overall satellite test service. The purpose of this new Mi-scale test facility is to determine the providing an overall satellite test service. The purpose of this new Mi-scale test facility is to determine the radioelectric characteristics of integrated satellite antennas covering: (1) classic antenna tests such as radiation pattern and gain measurement, (2) payload specific end-to-end tests such as EIRP, SFD, G/T, Gain/Frequency, etc. The aim of this paper is: (1) to present the main and extra features of the MISTRAL compact range and the results of the intensive quiet zone probing; (2) to present the results of antenna and payload measurements confirming the high quality of this test facility.

Author

Antenna Radiation Patterns; Satellite Antennas; Space Environment Simulation; Test Facilities; Anechoic Chambers

19990040637 Newcastle-upon-Tyne Univ., Dept. of Computing Science, Newcastle, UK

Metabroker: A Generic Broker for Electronic Commerce

Caughey, S., Newcastle-upon-Tyne Univ., UK; Ingham, D., Newcastle-upon-Tyne Univ., UK; Watson, P., Newcastle-upon-Tyne Univ., UK; Mar. 1998; 24p; In English

Report No.(s): PB99-122616; TRS-635; Copyright; Avail: Issuing Activity (Natl Technical Information Service (NTIS)), Microfiche

In this paper, the authors highlight the requirement for brokering services for electronic commerce and describe the design of the Metabroker system, a generic framework for creating electronic brokers. The aim is to provide a framework that provides commonly-required functionality and support for popular communication protocols and data formats. Specialist brokers are then created by populating the base framework with the necessary business logic to support the area of speciality of the broker. The authors' design integrates distributed object, metadata and object database technologies.

NTIS

Commerce; Communication Networks; Data Management; Information Systems

19990040759 California Univ., Electrical Engineering Dept., Los Angeles, CA USA

Multi-Wavelength Optical Code-Division-Multiplexing Based on Passive, Linear, Unitary Filters ***Final Report, 30 Sep. 1995 - 29 Nov. 1998***

Yablonovitch, Eli; Nov. 29, 1998; 10p; In English

Contract(s)/Grant(s): F49620-95-1-0534

Report No.(s): AD-A361203; AFRL-SR-BL-TR-99-0094; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The bulk results form the research can be found in Mr. Cedric Lam's Ph.D. dissertation, Multiple-wavelength Optical Coded-Division-Multiple-Access Communication Systems, published by UCLA in 1999. The main principle of optical CDMA is similar to radio CDMA. Instead of transmitting signals using only the necessary bandwidth, the signal energy is spread over a frequency spectrum, much broader than required to carry to information, by an encoding operation.

DTIC

Optical Communication; Multiple Access

19990040979 Wordsmiths Training and Consulting, Detroit, MI USA

Excellence Through Communications: Clear Oral Presentations

Bell, Marilyn E., Wordsmiths Training and Consulting, USA; Proceedings from the 1998 Occupational Health Conference: Benchmarking for Excellence; February 1999, pp. 81-84; In English; See also 19990040967; No Copyright; Avail: CASI; A01, Hardcopy; A03, Microfiche

Public speaking is a universal fear that most people will admit to. In fact, researchers say that public speaking is the number one fear of people in this country. Fear is an immobilizing emotional state that prevents us from meeting challenges effectively. The inaction caused by fear sets into motion the very things that we are anxious about. It focuses our attention and energy on exactly what we do not want to happen. The fears that wreck the poise and confidence of presenters are usually associated with embarrassment, inability to control important elements of the presentation, negative audience reactions, or with the potential for failure. Concentrating on these things will energize and activate "Murphy's Law" every time. Experienced presenters are not

deterred by negative feelings that they all experience. The information and exercises in this report contain ideas for reducing fears, anxieties, nervousness, and stress as your presentation approaches.
Derived from text
Public Speaking; Emotional Factors; Fear; Human Reactions

19990040980 Wordsmiths Training and Consulting, Detroit, MI USA
Excellence Through Communications: Clear Technical Writing
Bell, Marilynn E., Wordsmiths Training and Consulting, USA; Proceedings from the 1998 Occupational Health Conference: Benchmarking for Excellence; February 1999, pp. 85-91; In English; See also 19990040967; No Copyright; Avail: CASI; A02, Hardcopy; A03, Microfiche

The secret of effective, efficient writing is to remember the reader. This key to strong writing is especially important to messages that require action from the reader. to be efficient and to inspire efficiency in others, a writer needs to learn these four truths: (1) Readers are busy; (2) Readers are self-involved; (3) Readers are goal-oriented; and (4) Readers are unequal.
Derived from text
Technical Writing; Reading

19990040984 Bionetics Corp., Cocoa Beach, FL USA
Essential Components of the Occupational Medicine Program
Ferguson, Emmett B., Jr., Bionetics Corp., USA; Proceedings from the 1998 Occupational Health Conference: Benchmarking for Excellence; February 1999, pp. 102-104; In English; See also 19990040967; No Copyright; Avail: CASI; A01, Hardcopy; A03, Microfiche

The information assembled and presented here is a refined addition of the information presented and discussed at the video conference with NASA Center Medical Director's and Contracting Officer's Technical Representatives about two months ago. The comments provided at that time on the essential components have been incorporated into this presentation. The intent is to again review the essential components before a final draft is circulated to the NASA Centers and presented to the Executive Council. The importance of this document is that it may become the minimum requirement of all occupational medicine services within the Agency and a measurement against which programs will be evaluated. It may also become the benchmark for procurement of occupational medicine services in the Agency. The other potential benefit is that such a document can provide for standardization of services and perhaps prevent reduction in workforce beyond that necessary to provide these essential elements.
Derived from text
Standardization; NASA Programs; Health; Medical Services

33
ELECTRONICS AND ELECTRICAL ENGINEERING

Includes test equipment and maintainability; components, e.g., tunnel diodes and transistors; microminiaturization; and integrated circuitry. For related information see also 60 Computer Operations and Hardware and 76 Solid-State Physics.

19990038345 Optical Society of America, Washington, DC USA
Organization of the Integrated Photonics Topical Meeting, Volume 4, Postconference Edition ***Final Report, 1 Mar. 1998 - 28 Feb. 1999***
Fantone, Stephen D.; Mar. 22, 1999; 480p; In English, 30 Mar. - 1 Apr. 1998, Victoria, Colombia
Contract(s)/Grant(s): N00014-98-1-0458
Report No.(s): AD-A361153; No Copyright; Avail: CASI; A21, Hardcopy; A04, Microfiche

The Integrated Photonics Research Topical Meeting provided a forum for the presentation and discussion of new, previously unpublished results involving all experimental and theoretical aspects of integrated and guided-wave optics. These included the design, simulation, fabrication, materials, characterization, packaging, and application of photonic devices. Some of the topics covered at this meeting were the following: (1) Compound semiconductor photonic devices; (2) Dielectric waveguides and photonic devices; (3) Modeling, numerical simulation, and theory; and (4) Photonic manufacturing, packaging and prototyping.
DTIC
Photonics; Integrated Optics; Semiconductor Devices; Numerical Analysis; Dielectric Waveguides; Packaging

19990038346 Technical Univ. of Budapest, Dept. of electron devices, Hungary

Thermal and Electro-Thermal Modeling and Simulation Techniques for Multichip Modules ***Final Report***

Rencz, Marta K., Technical Univ. of Budapest, Hungary; Szekely, Vladimir, Technical Univ. of Budapest, Hungary; Kerecsen, Istvanne, Technical Univ. of Budapest, Hungary; Dec. 10, 1998; 38p; In English

Contract(s)/Grant(s): F61775-98-WE040

Report No.(s): AD-A361147; EOARD-SPC-98-4023; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report results from a contract tasking Technical University of Budapest Department of Electron Devices as follows: The contractor will investigate the issues and problems of coupled electro-thermal M&S of Mixed Technology Multichip Modules (MT-MCMs). MT-MCMs for this project will be defined as a mixtures of high performance computing, microelectromechanical systems, and microfluidic systems. The use of M&S will be investigated for each of the generic steps of the design process flow as shown in the proposal. The contractor will determine the most cost effective M&S approach for each step in the design process. The possibilities of integrating the existing fast and accurate design tools of TUB into the AFRL design flow have to be investigated, and the optimal M&S approach determined.

DTIC

Chips (Electronics); Thermal Simulation; Modules; Electronic Equipment

19990038351 Department of Defense, Washington, DC USA

Identification of functional components in combinational circuits

Doom, T. E., Department of Defense, USA; White, J. L., Department of Defense, USA; Wojcik, A. S., Department of Defense, USA; Chisholm, G. H., Department of Defense, USA; Jan. 31, 1998; 49p; In English

Report No.(s): DE98-004621; ANL/DIS/TM-47; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Identifying the subcircuits in a detailed circuit description is a fundamental operation in both circuit validation and design recovery. Existing identification techniques rely on finding an exact match for a subcircuit structure within the description. These techniques fail to identify subcircuits that are functionally equivalent but have been obfuscated because a different technology is being used or because the design has been optimized. This report presents a mechanism for identifying subcircuits that are functionally equivalent, irrespective of obfuscating details. It also describes the initial progress made in transforming detailed circuit descriptions into corresponding descriptions based on subcircuits. Such progress depends on enumerating all of the candidate subcircuits within the original detailed description and functionally matching each candidate. The report presents unique solutions for reducing the amount of computation needed for this enumeration.

NTIS

Identifying; Circuits; Subassemblies

19990038363 Department of Energy, Assistant Secretary for Energy Efficiency and Renewable Energy, Washington, DC USA

Characterization of carbon-based electrochemical capacitor technology from Maxwell Energy Products, Inc.

Wright, R. B., Department of Energy, USA; Murphy, T. C., Department of Energy, USA; Apr. 30, 1998; 208p; In English

Report No.(s): DE98-056059; DOE/ID-10634; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The electrochemical capacitor devices described in this report were deliverables from the US Department of Energy--Idaho Operations Office (DOE-ID) Contract No. DE-AC07-92ID13404 as part of the US Department of Energy's (DOE) High Power Energy Storage Program. The Idaho national Engineering and Environmental Laboratory (INEEL) has responsibility for technical management, testing, and evaluation of high-power batteries and electrochemical capacitors under this Program. The DOE has developed various electrochemical capacitors as candidate power assist devices for the Partnership for a New Generation of Vehicles (PNGV) fast response engine requirement. This contract with Maxwell Energy Products, Inc. (Maxwell) was intended to develop a high-energy-density, high-power-density ultracapacitor that is capable of load leveling batteries in electric vehicles. The performance criteria for this device are delivery of 5 W (center-dot) h/kg of useful energy that can be used by the vehicle at an average power rating of 600 W/kg. The capacitor must also have an overall charge/discharge efficiency of 90%, and a useful life of more than 100,000 discharge cycles. The deliverables reported on here are those prepared by Maxwell Energy Products, Inc. at various stages of their developmental program. Deliverables were sent to the INEEL's Energy Storage Technologies (EST) Laboratory for independent testing and evaluation. This report describes performance testing on three sets of capacitors delivered over a two year period. Additional testing has been done on Set (number-sign)2 described herein, as well as on an additional deliverable from Maxwell. These tests results will be documented in a follow-up report.

NTIS

Carbon; Capacitors; Characterization; Electrochemistry

19990038380 Department of Energy, Washington, DC USA

Solder flow over fine line PWB surface finishes

Hosking, F. M., Department of Energy, USA; Hernandez, C. L., Department of Energy, USA; Dec. 31, 1998; 7p; In English

Report No.(s): DE98-007100; SAND-98-0635C; CONF-981022; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The rapid advancement of interconnect technology has stimulated the development of alternative printed wiring board (PWB) surface finishes to enhance the solderability of standard copper and solder-coated surfaces. These new finishes are based on either metallic or organic chemistries. As part of an ongoing solderability study, Sandia National Laboratories has investigated the solder flow behavior of two azole-based organic solderability preservations, immersion Au, immersion Ag, electroless Pd, and electroless Pd/Ni on fine line copper features. The coated substrates were solder tested in the as-fabricated and environmentally-stressed conditions. Samples were processed through an inerted reflow machine. The azole-based coatings generally provided the most effective protection after aging. Thin Pd over Cu yielded the best wetting results of the metallic coatings, with complete dissolution of the Pd overcoat and wetting of the underlying Cu by the flowing solder. Limited wetting was measured on the thicker Pd and Pd over Ni finishes, which were not completely dissolved by the molten solder. The immersion Au and Ag finishes yielded the lowest wetted lengths, respectively. These general differences in solderability were directly attributed to the type of surface finish which the solder came in contact with. The effects of circuit geometry, surface finish, stressing, and solder processing conditions are discussed.

NTIS

Surface Finishing; Solders; Printed Circuits; Metal Surfaces

19990039102 Army Research Lab., Sensors Directorate, Adelphi, MD USA

Band-Bending Effect of Low-Temperature GaAs on a Pseudomorphic Modulation-Doped Field-Effect Transistor ***Final Report, 1 Jun. 1998 - 15 Jan. 1999***

Sun, W. D.; Pollak, Fred H.; Folkes, Patrick A.; Gumbs, Godfrey A.; Mar. 1999; 16p; In English

Report No.(s): AD-A361412; ARL-TR-1933; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Low-temperature photoluminescence (PL) measurements on pseudomorphic modulation-doped transistors with a low-temperature (LT) GaAs layer in the GaAs buffer layer clearly show a decrease in the quantum-well/PL transition energies compared to a structure with no LT GaAs. Self-consistent calculations of the electron and hole band structure confirm that the observed increase in the redshift in PL energies with increasing quantum-well/LT-GaAs spacing can be attributed to band bending induced by the Fermi level pinning at the undoped-GaAs/LT-GaAs interface.

DTIC

Gallium Arsenides; Field Effect Transistors; Photoluminescence; Doped Crystals

19990039124 Department of Energy, Office of Financial Management and Controller, Washington, DC USA

SPICE Level 3 and BSIM3v3.1 characterization of monolithic integrated CMOS- MEMS devices

Staple, B. D., Department of Energy, USA; Watts, H. A., Department of Energy, USA; Dyck, C., Department of Energy, USA; Griego, A. P., Department of Energy, USA; Hewlett, F. W., Department of Energy, USA; Dec. 31, 1998; 11p; In English; Micromachining and Microfabrication, USA

Report No.(s): DE98-006179; SAND-98-1870C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The monolithic integration of MicroElectroMechanical Systems (MEMS) with the driving, controlling, and signal processing electronics promises to improve the performance of micromechanical devices as well as lower their manufacturing, packaging, and instrumentation costs. Key to this integration is the proper interleaving, combining, and customizing of the manufacturing processes to produce functional integrated micromechanical devices with electronics. The authors have developed a MEMS-first monolithic integrated process that first seals the micromechanical devices in a planarized trench and then builds the electronics in a conventional CMOS process. to date, most of the research published on this technology has focused on the performance characteristics of the mechanical portion of the devices, with little information on the attributes of the accompanying electronics. This work attempts to reduce this information void by presenting the results of SPICE Level 3 and BSIM3v3.1 model parameters extracted for the CMOS portion of the MEMS-first process. Transistor-level simulations of MOSFET current, capacitance, output resistance, and transconductance versus voltage using the extracted model parameters closely match the measured data. Moreover, in model validation efforts, circuit-level simulation values for the average gate propagation delay in a 101-stage ring oscillator are within 13--18% of the measured data. In general, the BSIM3v3.1 models provide improved accuracy over the SPICE Level 3 models. These results establish the following: (1) the MEMS-first approach produces functional CMOS devices integrated on

a single chip with MEMS devices and (2) the devices manufactured in the approach have excellent transistor characteristics. Thus, the MEMS-first approach renders a solid technology foundation for customers designing in the technology.
NTIS
Microelectromechanical Systems; Fabrication; Microelectronics; CMOS; Functional Design Specifications; Manufacturing

19990039165 Naval Postgraduate School, Dept. of Electrical and Computer Engineering, Monterey, CA USA
Analysis of a Pulse Width Modulation (PWM) Resonant Buck Chopper for Use as a Ship Service Converter Module
Ciezki, John G.; Ashton, Robert W.; Jan. 1999; 71p; In English
Contract(s)/Grant(s): N00167-98-WR-80279
Report No.(s): AD-A361136; NPS-EC-99-003; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

The Navy's interest in implementing a DC Zonal Electric Distribution System (DC ZEDS) in the next generation of surface combatant has motivated considerable research work into dc-dc converters. The switching frequency of a hard-switched dc-dc converter is limited by the maximum admissible switching losses allowed by the switch, heat sink, and cooling process. Also, hard-switched converters contribute significant Electromagnetic Interference (EMI) concerns for the system. This study provides a background analysis into resonant converters which utilize zero-voltage-switching and zero-current-switching techniques to mitigate the aforementioned concerns and facilitate high-bandwidth control loops. In particular, one candidate circuit is identified which can be readily realized using existing hardware and a straightforward control. The report documents the modes of operation of the circuit, sets forth the governing differential equation and mode-transition conditions, examines an ACSL simulation representation of the circuit, formulates design criteria for component selection, identifies key fabrication nuances, and documents a PSpice simulation of the circuit. Both simulation models are used to explain the operating modes of the circuit, provide insight into parameter selection, and ultimately to design the proper control of the circuit.
DTIC
Ships; Service Modules; Design Analysis; Voltage Converters (DC to DC); Electric Choppers; Pulse Duration Modulation

19990039175 Princeton Univ., Dept. of Material and Aerospace Engineering, NJ USA
Investigations on Degradation Mechanisms for Ferroelectric Actuator Design ***Final Report, 1 Sep. 1997 - 30 Sep. 1998***
Suo, Zhigang; Sep. 30, 1998; 8p; In English; Sponsored in part by Contract N00014-97-1-1028
Contract(s)/Grant(s): N00014-93-1-0110; N00014-97-1-0260
Report No.(s): AD-A361484; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Among various materials for solid state actuators (e.g., magnetostrictors, shape memory alloys, and ferroelectric ceramics), ferroelectric ceramics are most versatile, offering a combination of large actuation work per unit volume, fast response, low cost, and electric field control. Ferroelectrics have long been used in non-structural applications (e.g., pressure sensors, microphones) that require small forces and displacements. Their brittleness has not been the limiting factor in such applications. Recent applications include large-scale adaptive structures, active vibration control, and precise positioning, all requiring large actuation work under repeated loading. Although each application involves many technical issues (e.g., sensing, signal processing, actuation, structural design), it is the reliability of actuators that has become the limiting factor. The present actuator design practice is empirical: no data base and analytical tool exist to assure long term reliability. This is in contrast with most other structural elements, where years of experience and research have accumulated such data bases and tools. Often it is this lack of reliability assurance that stands in the way of integrating actuators into structures. The object of the proposed research is to create a computational tool to design reliable actuators. The work focuses on multilayer actuators, although ideas and tools to be developed would be relevant to other types of actuators.
DTIC
Actuators; Ferroelectric Materials; Adaptive Control; Ceramics; Electric Fields

19990039211 Department of Energy, Washington, DC USA
Effects of electrode cleaning and conditioning on the performance of high-energy, pulsed-power devices
Cuneo, M. E., Department of Energy, USA; Dec. 31, 1998; 12p; In English; 18th; Discharges and Electrical Insulation in Vacuum, USA
Report No.(s): DE98-005897; SAND-98-1396C; CONF-980818; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

High-energy pulsed-power devices routinely access field strengths above those at which broad-area, cathode-initiated, high-voltage vacuum-breakdown occur (amp;amp greater than; 1e7--3e7 V/m). Examples include magnetically-insulated- transmission- lines and current convolutes, high-current-density electron and ion diodes, high-power microwave devices, and cavities and other structures for electrostatic and RF accelerators. Energy deposited in anode surfaces may exceed anode plasma thermal-

desorption creation thresholds on the time-scale of the pulse. Stimulated desorption by electron or photon bombardment can also lead to plasma formation on electrode or insulator surfaces. Device performance is limited above these thresholds, particularly in pulse length and energy, by the formation and expansion of plasmas formed primarily from electrode contaminants. In-situ conditioning techniques to modify and eliminate the contaminants through multiple high-voltage pulses, low base pressures, RF discharge cleaning, heating, surface coatings, and ion- and electron-beam surface treatment allow access to new regimes of performance through control of plasma formation and modification of the plasma properties. Experimental and theoretical progress from a variety of devices and small scale experiments with a variety of treatment methods will be reviewed and recommendations given for future work.
NTIS
Electrodes; Cleaning; Surface Finishing; Particle Accelerators

19990039545 Army Research Lab., Human Research and Engineering Directorate, Aberdeen Proving Ground, MD USA
In-Bore Magnetic Field Management ***Final Report, Oct. 1997 - Sep. 1998***
Zielinski, Alex; Mar. 1999; 45p; In English
Contract(s)/Grant(s): Proj-1L162622AH80
Report No.(s): AD-A361482; ARL-TR-1914; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The turbine/alternator T/A) in the M734A1 Multi-Option Fuze for Mortar (MOFM) was identified as a component whose performance was altered by exposure to the in-bore magnetic induction produced by the armature in an electromagnetic railgun. Passive shielding techniques were developed to attenuate the exposure field. A model, based on the experimental results, was used to predict shielding effectiveness. Results were verified by subjecting T/As to the exposure field. No statistically significant changes in T/A output were observed for magnetic induction less than 0.06 T. Significant degradation in performance was observed for magnetic induction greater than 0.1 T. Active shielding was also demonstrated. This technique was implemented with coil windings mounted in the bore insulators and powered by an external power supply. The in-bore magnetic induction produced by the armature was cancelled down-bore of the armature. The technique provides for mitigation of large magnitude exposure fields where otherwise passive shielding may become unwieldy.
DTIC
Electromagnetic Shielding; AC Generators; Degradation; Railgun Accelerators

19990039546 Army Research Lab., Human Research and Engineering Directorate, Aberdeen Proving Ground, MD USA
Mechanical and Microstructural Evaluation of Barium Strontium Titanate Thin Films for Improved Antenna Performance and Reliability ***Final Report, Sep. 1997 - Jan. 1998***
Hubbard, C. W.; Fountzoulas, C. G.; Cole, M. W.; Sengupta, S.; Apr. 1999; 23p; In English
Report No.(s): AD-A361481; ARL-TR-1930; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Ferroelectric barium strontium titanate (Ba(1-x)SR(x)TiO3 BSTO) films of 1-micron nominal thickness were deposited on single crystals of sapphire and electroded substrates at substrate temperatures varying from 30 deg C to 700 deg C. The microstructure of the thin films was columnar at all substrate deposition temperatures. The film microhardness showed a trend toward increased hardness with substrate temperature. Furthermore, with the elevation in substrate temperature, there was a parallel increase in film-substrate adhesion measurements, while the cohesion measurements were not influenced by substrate temperature.
DTIC
Antenna Arrays; Ferroelectric Materials; Ferroelectricity

19990039578 Department of Energy, Office of Financial Management and Controller, Washington, DC USA
Sandia Agile MEMS Prototyping, Layout Tools, Education and Services Program
Schriner, H., Department of Energy, USA; Davies, B., Department of Energy, USA; Sniegowski, J., Department of Energy, USA; Rodgers, M. S., Department of Energy, USA; Allen, J., Department of Energy, USA; May 31, 1998; 7p; In English; 2nd; Engineering Design and Automation, USA
Report No.(s): DE98-005708; SAND-98-0092C; CONF-980810; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Research and development in the design and manufacture of Microelectromechanical Systems (MEMS) is growing at an enormous rate. Advances in MEMS design tools and fabrication processes at Sandia National Laboratories' Microelectronics Development Laboratory (MDL) have broadened the scope of MEMS applications that can be designed and manufactured for both military and commercial use. As improvements in micromachining fabrication technologies continue to be made, MEMS designs can become more complex, thus opening the door to an even broader set of MEMS applications. In an effort to further

research and development in MEMS design, fabrication, and application, Sandia National Laboratories has launched the Sandia Agile MEMS Prototyping, Layout Tools, Education and Services Program or SAMPLES program. The SAMPLES program offers potential partners interested in MEMS the opportunity to prototype an idea and produce hardware that can be used to sell a concept. The SAMPLES program provides education and training on Sandia's design tools, analysis tools and fabrication process. New designers can participate in the SAMPLES program and design MEMS devices using Sandia's design and analysis tools. As part of the SAMPLES program, participants' designs are fabricated using Sandia's 4 level polycrystalline silicon surface micromachine technology fabrication process known as SUMMiT (Sandia Ultra-planar, Multi-level MEMS Technology). Furthermore, SAMPLES participants can also opt to obtain state of the art, post-fabrication services provided at Sandia such as release, packaging, reliability characterization, and failure analysis. This paper discusses the components of the SAMPLES program.

NTIS

Microelectronics; Research and Development; Design Analysis; Manufacturing; Microelectromechanical Systems

19990039579 Department of Energy, Office of Financial Management and Controller, Washington, DC USA

Designing microelectromechanical systems-on-a-chip in a 5-level surface micromachine technology

Rodgers, M. S., Department of Energy, USA; Sniegowski, J. J., Department of Energy, USA; May 31, 1998; 6p; In English; 2nd; Engineering Design and Automation, USA

Report No.(s): DE98-005710; SAND-98-0393C; CONF-980810; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

A new 5-level polysilicon surface micromachine process has been developed that offers significantly increased system complexity, while further promoting the manufacturability and reliability of microscopic mechanical systems. In general, as complexity increases, reliability suffers. This is not necessarily the case, however, with MicroElectroMechanical Systems (MEMS). In fact, utilizing additional levels of polysilicon in structures can greatly increase yield, reliability, and robustness. Surface micromachine devices are built thousands at a time using the infrastructure developed to support the incredibly reliable microelectronics industry, and the batch fabrication process utilized in the 5-level technology further increases reliability and reduces cost by totally eliminating post assembly.

NTIS

Microelectronics; Machining; Procedures; Design Analysis; Technology Assessment; Microelectromechanical Systems; Fabrication

19990039583 Department of Energy, Washington, DC USA

Manufacturing microsystems-on-a-chip with 5-level surface micromachining technology

Sniegowski, J., Department of Energy, USA; Rodgers, M. S., Department of Energy, USA; May 31, 1998; 6p; In English; 2nd; Engineering Design and Automation, USA

Report No.(s): DE98-005722; SAND-98-1129C; CONF-980810; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

An agile microsystem manufacturing technology has been developed that provides unprecedented 5 levels of independent polysilicon surface-micromachine films for the designer. Typical surface-micromachining processes offer a maximum of 3 levels, making this the most complex surface-micromachining process technology developed to date. Leveraged from the extensive infrastructure present in the microelectronics industry, the manufacturing method of polysilicon surface-micromachining offers similar advantages of high- volume, high-reliability, and batch-fabrication to microelectromechanical systems (MEMS) as has been accomplished with integrated circuits (ICs). These systems, comprised of microscopic-sized mechanical elements, are laying the foundation for a rapidly expanding, multi-billion dollar industry 2 which impacts the automotive, consumer product, and medical industries to name only a few.

NTIS

Microelectronics; Manufacturing; Technology Assessment; Microelectromechanical Systems; Silicon Polymers

19990039620 Department of Energy, Washington, DC USA

Multilayer ultra high gradient insulator technology

Sampayan, S. E., Department of Energy, USA; Vitello, P. A., Department of Energy, USA; Krogh, M. L., Department of Energy, USA; Elizondo, J. M., Department of Energy, USA; Mar. 27, 1998; 7p; In English; 18th; Discharges and Electrical Insulation in Vacuum, USA

Report No.(s): DE98-057732; UCRL-JC-128812; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

We are investigating a novel insulator concept which involves the use of alternating layers of conductors and insulators with periods less than 1 mm. These structures perform many times better (about 1.5 to 4 times higher breakdown electric field) than conventional insulators in long pulse, short pulse, and alternating polarity applications. We present our ongoing studies investigating the degradation of the breakdown electric field resulting from surface roughness, the effect of gas pressure, and the performance of the insulator structure under bi-polar stress. Further, we present our initial modeling studies.
NTIS
Insulators; Interlayers; Electric Conductors; Polarity

19990040231 Department of Energy, Office of Energy Research, Washington, DC USA
Grain orientation mapping of passivated aluminum interconnect wires with X-ray micro-diffraction
MacDowell, A. A., Department of Energy, USA; Padmore, H. A., Department of Energy, USA; Thompson, A. C., Department of Energy, USA; Chang, C. H., Department of Energy, USA; Patel, J. R., Department of Energy, USA; Jun. 30, 1998; 5p; In English; Sponsored by Materials Research Society, USA
Report No.(s): DE98-059381; LBNL-42053; LSBL-477; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

A micro x-ray diffraction facility is under development at the Advanced Light source. Spot sizes are typically about 1-micro-m size generated by means of grazing incidence Kirkpatrick-Baez focusing mirrors. Photon energy is either white of energy range 6--14 keV or monochromatic generated from a pair of channel cut crystals. A Laue diffraction pattern from a single grain in passivated 2-micro-m wide bamboo structured Aluminum interconnect line has been recorded. Acquisition times are of the order of a few seconds. The Laue pattern has allowed the determination of the crystallographic orientation of individual grains along the line length. The experimental and analysis procedures used are described, as is a grain orientation result. The future direction of this program is discussed in the context of strain measurements in the area of electromigration.
NTIS
X Ray Diffraction; Light Sources; Laue Method; Strain Measurement; Electromigration; Diffraction Patterns; Crystals

19990040280 Middle Tennessee State Univ., Dept. of Chemistry, Murfreesboro, TN USA
Polyelectrolytes for Battery Applications: Synthetic Approaches and Precursor Properties
Zheng, Mu, Middle Tennessee State Univ., USA; Manka, Jason T., Middle Tennessee State Univ., USA; Friedli, Andrienne C., Middle Tennessee State Univ., USA; NASA Microgravity Materials Science Conference; February 1999, pp. 225-228; In English; See also 19990040241
Contract(s)/Grant(s): PRF-30202-GB7; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Widespread interest exists for the development of polymer electrolytes for use in solid state batteries. These, devices have applications in energy storage and power supply for the human exploration and development of space (HEDS), as well as for communications devices on Earth. On a molecular level, the polyelectrolytes must he flexible enough to promote ion migration, yet have diffuse charges to prevent trapping of the ions at a given site. Here we report our progress toward new well-defined polyelectrolyte materials.
Derived from text
Electric Batteries; Electrolytes; Solid State; Polymers; Power Supplies

19990040477 NASA Goddard Space Flight Center, Greenbelt, MD USA
Cable Bundle Wire Derating
Lundquist, Ray A., NASA Goddard Space Flight Center, USA; Leidecker, Henning, NASA Goddard Space Flight Center, USA; 20th Space Simulation Conference: The Changing Testing Paradigm; February 1999, pp. 149-157; In English; See also 19990040464; No Copyright; Avail: CASI; A02, Hardcopy; A03, Microfiche

The allowable operating currents of electrical wiring when used in the space vacuum environment is predominantly determined by the maximum operating temperature of the wire insulation. For Kapton insulated wire this value is 200 degree C. Guidelines provided in the Goddard Space Flight Center (GSFC) Preferred Parts List (PPL) limit the operating current of wire within vacuum to ensure the maximum insulation temperature is not exceeded. For 20 AWG wire, these operating parameters are: (1) 3.7 amps per wire (2) bundle of 15 or more wires (3) 70 C environment (4) vacuum of 10(exp -5) torr or less to determine the behavior and temperature of electrical wire at different operating conditions, a thermal vacuum test was performed on a representative electrical harness of the Hubble Space Telescope (HST) power distribution system. This paper describes the test and the results.
Author
Kapton (Trademark); Operating Temperature; Thermal Vacuum Tests; Electric Wire; Electrical Insulation; Power Supply Circuits

19990040579 Department of Energy, Office of Energy Research, Washington, DC USA

Processing and fabrication of high-(Tc) superconductors for electric power applications

Balachandran, U., Department of Energy, USA; Iyer, A. N., Department of Energy, USA; Goretta, K. C., Department of Energy, USA; Haldar, P., Department of Energy, USA; Sep. 30, 1997; 17p; In English; 4th; IUMRS-ICA, USA

Report No.(s): DE98-050042; ANL/ET/CP-93095; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Recent developments in the powder-in-tube fabrication of (Bi,Pb)2 SR2Ca2Cu3O(x) tapes include identification of high current transport regions of the superconductor core, optimization of conductor design and processing to take advantage of these high current regions, optimization of superconductor powders and heat treatments, and incorporation of flux pinning defects into the superconductor grains. These developments are briefly discussed and their implications are assessed.

NTIS

Fabrication; Critical Temperature; High Temperature Superconductors

19990040678 Los Alamos National Lab., NM USA

Marginal stability of d-wave superconductor: Spontaneous P and T violation in the presence of magnetic impurities

Balatsky, A. V.; May 13, 1998; 4p; In English; Stripes and high T(sub c) superconductivity

Report No.(s): DE99-000738; LA-UR-98-2174; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The author argues that the d(sub x(exp 2)-y(exp 2))-wave superconductor is marginally stable in the presence of external perturbations. Subjected to the external perturbations by magnetic impurities, it develops a secondary component of the gap, complex d(sub xy), to maximize the coupling to impurities and lower the total energy. The secondary d(sub xy) component exists at high temperatures and produces the full gap (approximately) 20 K in the single particle spectrum around each impurity, apart from impurity induced broadening. At low temperatures the phase ordering transition into global d(sub x(exp 2)-y(exp 2)) + id(sub xy) state occurs.

NTIS

Stability; Impurities; High Temperature Superconductors

19990040827 Lawrence Livermore National Lab., Livermore, CA USA

LCR Bridge measurements at elevated operating levels

Wilson, M. J.; Dec. 01, 1997; 23p; In English

Report No.(s): DE98-058820; UCRL-JC-125796; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

A critical part in the design of high voltage systems is the selection of the appropriate discrete components The proper selection involves consideration to the basic equivalent electrical parameters of inductance, capacitance, and resistance. The technique discussed in this paper involves the use of a standard Hewlett Packard LCR Bridge to measure the electrical parameters of a selected component while it is at its operating level. This process not only provides discrete component values at operating stress but also provides limited information of frequency information at the internal frequency steps. Capacitance is the principal parameter of interest and is highly stress related. The significance of a varying capacitance as a function of voltage is the direct relationship to the available stored energy Additional concerns of system frequency response depend on the application.

NTIS

Electric Bridges; Electrical Measurement

19990040954 Department of Energy, Washington, DC USA

Fabrication and testing of optics for EUV projection lithography

Taylor, J.; Mar. 13, 1998; 6p; In English; Diffractive optic and micro optics, 1998

Report No.(s): DE98-058758; UCRL-JC-128290; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Extreme Ultraviolet Lithography (EUVL) is a leading candidate as a stepper technology for fabricating the ”0.1 (micro)m generation” of microelectronic circuits. EUVL is an optical printing technique qualitatively similar to Deep UV Lithography (DUVL), except that 11-13 nm wavelength light is used instead of 193-248 nm. The feasibility of creating 0.1(micro)m features has been well-established using small-field EWL printing tools, and development efforts are currently underway to demonstrate that cost-effective production equipment can be engineered to perform full-width ring-field imaging consistent with high wafer throughput rates. Ensuring that an industrial supplier base will be available for key components and subsystems is crucial to the success of EUVL. In particular, the projection optics are the heart of the EUVL imaging system, yet they have figure and finish specifications that are beyond the state-of-the-art in optics manufacturing. Thus it is important to demonstrate that industry will be able to fabricate and certify these optics commensurate with EUVL requirements. The goal of this paper is to demonstrate that

procuring EUVL projection optical substrates is feasible. This conclusion is based on measurements of both commercially-available and developmental substrates.
NTIS
Extreme Ultraviolet Radiation; Fabrication; Lithography

19990041066 NASA Lewis Research Center, Cleveland, OH USA
Non-Micropipe Dislocations in 4H-SiC Devices: Electrical Properties and Device Technology Implications
Neudeck, P. G., NASA Lewis Research Center, USA; Huang, W., State Univ. of New York, USA; Dudley, M., State Univ. of New York, USA; Fazi, C., Army Research Lab., USA; Materials Research Society Proceedings; 1998; Volume 512, pp. 107-112; In English
Contract(s)/Grant(s): DARPA Order D149; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

It is well-known that SiC wafer quality deficiencies are delaying the realization of outstandingly superior 4H-SiC power electronics. While efforts to date have centered on eradicating micropipes (i.e., hollow core super-screw dislocations with Burgers vectors greater than 2c), 4H-SiC wafers and epilayers also contain elementary screw dislocations (i.e., Burgers vector = lc with no hollow core) in densities on the order of thousands per sq sm, nearly 100-fold micropipe densities. While not nearly as detrimental to SiC device performance as micropipes, it has been previously shown that diodes containing elementary screw dislocations exhibit a 5% to 35% reduction in breakdown voltage, higher pre-breakdown reverse leakage current, softer reverse breakdown I-V knee, and concentrated microplasmic breakdown current filaments when measured under DC testing conditions. This paper details the impact of elementary screw dislocations on the experimentally observed reverse-breakdown pulse-failure characteristics of low-voltage (less than 250 V) small-area (less than 5 x 10(exp -4)sq cm) 4H-SiC p(+)n diodes. The presence of elementary screw dislocations did not significantly affect the failure properties of these diodes when subjected to non-adiabatic breakdown-bias pulsewidths ranging from 0.1 microns to 20 microns in duration. Diodes with and without elementary screw dislocations exhibited positive temperature coefficient of breakdown voltage and high junction failure power densities well above die failure power densities exhibited by highly reliable silicon power rectifiers. This preliminary result, based on measurements from one wafer of SiC diodes, suggests that highly reliable low-voltage SiC rectifiers may be attainable despite the presence of elementary screw dislocations.
Author
Silicon Carbides; Semiconductor Devices; Electrical Properties; Technology Assessment; Wafers; Electrical Faults

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FLUID MECHANICS AND HEAT TRANSFER

Includes boundary layers; hydrodynamics; fluidics; mass transfer; and ablation cooling. For related information see also 02 Aerodynamics and 77 Thermodynamics and Statistical Physics.

19990039098 Naval Postgraduate School, Monterey, CA USA
Spray Generation From Free and Half-Free Jets
Vaidyanathan, Rajan; Mar. 1999; 74p; In English
Report No.(s): AD-A361417; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

This is an experimental investigation of the ligament and drop formation at the free surface of wall jets, flowing over sand-roughened plates, and on unbounded two-dimensional jets, discharging into atmosphere. Experiments were conducted with both fresh and simulated sea water. Measurements were made with several high-speed imagers and a pulsating laser system and analyzed through the use of appropriate software. The wall-jet Reynolds number ranged from 3.5 x 10(exp 4) to 8.5 x 10(exp 4), the Froude number from 15 to 30, and the Weber number from 3,000 to 7,500. The positions of the transition and primary breakup as well as the characteristics of the ligament forest and droplets were determined from the digitized images and interpreted in terms of the characteristics of the turbulent boundary layer and a phenomenological model based on our observations and measurements. The emphasis has been on the physics of the phenomenon rather than on the development of empirical relationships.
DTIC
Turbulent Boundary Layer; Jet Flow; Drops (Liquids); Wall Jets; Free Jets

19990039150 NASA Lewis Research Center, Cleveland, OH USA
Asymptotic Spreading Rate of Initially Compressible Jets: Experiment and Analysis
Zaman, K. B. M. Q., NASA Lewis Research Center, USA; Physics of Fluids; October 1998; Volume 10, No. 10, pp. 2652- 2660; In English; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

Experimental results for the spreading and centerline velocity decay rates for round, compressible jets, from a convergent and a convergent-divergent nozzle, are presented. The spreading rate is determined from the variation of streamwise mass flux obtained from Pitot probe surveys. Results for the far asymptotic region show that both spreading and centerline velocity decay rates, when nondimensionalized by parameters at the nozzle exit, decrease with increasing ”jet Mach number” M(sub J). Dimensional analysis with the assumption of momentum conservation, together with compressible flow calculations for the conditions at the nozzle exit, predict this Mach number dependence well. The analysis also demonstrates that an increase in the ”potential core length” of the jet occurring with increasing M(sub J), a commonly observed trend, is largely accounted for simply by the variations in the density and static pressure at the nozzle exit. The effect of decreasing mixing efficiency with increasing compressibility is inferred to contribute only partially to the latter trend.
Author
Asymptotic Methods; Compressible Flow; Jet Flow; Experimentation; Decay Rates; Velocity Measurement; Dimensional Analysis

19990040164 AYT Corp., Cleveland, OH USA
Heat Transfer on a Film-Cooled Rotating Blade Using a Two Equation Turbulence Model
Garg, Vijay K., AYT Corp., USA; International Journal of Rotating Machinery; 1998; Volume 4, No. 3, pp. 201-216; In English; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

A three-dimensional Navier-Stokes code has been used to compare the heat transfer coefficient on a film-cooled, rotating turbine blade. The blade chosen is the ACE rotor with five rows containing 93 film cooling holes covering the entire span. This is the only film-cooled rotating blade over which experimental data is available for comparison. Over 2.278 million grid points are used to compute the flow over the blade including the tip clearance region, using Coakley’s q-omega turbulence model. Results are also compared with those obtained by Garg and Abhari (1997) using the zero-equation Baldwin-Lomax (B-L) model. A reasonably good comparison with the experimental data is obtained on the suction surface for both the turbulence models. At the leading edge, the B-L model yields a better comparison than the q-omega model. On the pressure surface, however, the comparison between the experimental data and the prediction from either turbulence model is poor. A potential reason for the discrepancy on the pressure surface could be the presence of unsteady effects due to stator-rotor interaction in the experiments which are not modeled in the present computations. Prediction using the two-equation model is in general poorer than that using the zero-equation model, while the former requires at least 40% more computational resources.
Author
Baldwin-Lomax Turbulence Model; Heat Transfer; Film Cooling; Turbine Blades; Turbulence Models; Rotary Wing Aircraft; Supersonic Turbines; Stator Blades

19990040198 NASA Marshall Space Flight Center, Huntsville, AL USA
Simulations of the Flow in Supersonic Turbines with Straight Centerline Nozzles
Dorney, Daniel J., Virginia Commonwealth Univ., USA; Griffin, Lisa W., NASA Marshall Space Flight Center, USA; Gundy-Burlet, Karen L., NASA Ames Research Center, USA; 1999; In English, 16 Jan. 1999, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

Sliding mode control systems are valued for their robust accommodation of uncertainties and their ability to reject disturbances. In this paper, a design methodology is proposed to eliminate the chattering phenomenon affecting sliding mode controlled plants with input unmodeled actuator dynamics of second order or greater. The proposed controller design is based on the relative degrees of the plant and the unmodeled actuator dynamics and the ranges of the uncertainties of the plant and actuator. The controller utilizes the pass filter characteristics of the physical actuating device to provide a smoothing effect on the discontinuous control signal rather than introducing any artificial dynamics into the controller design thus eliminating chattering in the system’s output response.
Author
Actuators; Controllers; Supersonic Turbines

19990040205 Institute for Computer Applications in Science and Engineering, Hampton, VA USA
Relaxation from Steady States Far from Equilibrium and the Persistence of Anomalous Shock Behavior in Weakly Ionized Gases *Final Report*
Rubinstein, Robert, Institute for Computer Applications in Science and Engineering, USA; Auslender, Aaron H., NASA Langley Research Center, USA; March 1999; 12p; In English
Contract(s)/Grant(s): NAS1-97046; RTOP 505-90-52-01
Report No.(s): NASA/CR-1999-209105; NAS 1.26:209105; ICASE -99-13; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The decay of anomalous effects on shock waves in weakly ionized gases following plasma generator extinction has been measured in the anticipation that the decay time must correlate well with the relaxation time of the mechanism responsible for the anomalous effects. When the relaxation times cannot be measured directly, they are inferred theoretically, usually assuming that the initial state is nearly in thermal equilibrium. In this paper, it is demonstrated that relaxation from any steady state far from equilibrium, including the state of a weakly ionized gas, can proceed much more slowly than arguments based on relaxation from near equilibrium states might suggest. This result justifies a more careful analysis of the relaxation times in weakly ionized gases and suggests that although the experimental measurements of relaxation times did not lead to an unambiguous conclusion, this approach to understanding the anomalous effects may warrant further investigation.
Author
Ionized Gases; Shock Waves; Plasma Decay; Plasmas (Physics)

19990040215 NASA Langley Research Center, Hampton,VA USA
Towards a Rational Model for the Triple Velocity Correlations of Turbulence
Younis, B. A., City Univ., UK; Gatski, T. B., NASA Langley Research Center, USA; Speziale, C. G., Boston Univ., USA; Apr. 1999; 18p; In English
Contract(s)/Grant(s): RTOP 522-31-61-01
Report No.(s): NASA/TM-1999-209134; L-17847; NAS 1.15:209134; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This paper presents a rational approach to modelling the triple velocity correlations that appear in the transport equations for the Reynolds stresses. All existing models of these correlations have largely been formulated on phenomenological grounds and are defective in one important aspect: they all neglect to allow for the dependence of these correlations on the local gradients of mean velocity. The mathematical necessity for this dependence will be demonstrated in the paper. The present contribution lies in the novel use of Group Representation Theory to determine the most general tensorial form of these correlations in terms of all the second- and third-order tensor quantities that appear in the exact equations that govern their evolution. The requisite representation did not exist in the literature and therefore had to be developed specifically for this purpose by Professor G. F. Smith. The outcome of this work is a mathematical framework for the construction of algebraic, explicit, and rational models for the triple velocity correlations that are theoretically consistent and include all the correct dependencies. Previous models are reviewed, and all are shown to be an incomplete subset of this new representation, even to lowest order.
Author
Correlation; Turbulence; Velocity; Rational Functions; Mathematical Models

19990040245 Florida Univ., Gainesville, FL USA
An Electrochemical Method to Visualize Flow and Measure Diffusivity in Liquid Metals
Anderson, T. J., Florida Univ., USA; Narayanan, R., Florida Univ., USA; NASA Microgravity Materials Science Conference; February 1999, pp. 19-24; In English; See also 19990040241; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

The main objective of this program is to develop and demonstrate a novel electrochemical sensor for determining the fluid dynamic state in low Prandtl number, opaque liquid metals at high temperature. The basic idea is to use solid state electrochemical cells constructed along the container boundaries to control and detect the concentration of a tracer species. In this project, yttria stabilized zirconia (YSZ) is used as a solid oxygen-ion-conducting electrolyte and separates a 'working' liquid metal electrode from a 'reference' electrode. Atomic oxygen, dissolved in the liquid metal at the ppm concentration level, is detected by electrochemical cells operating in the galvanic mode. The same cell configuration is also used to establish localized concentration boundary conditions through coulometric titration of oxygen. Information about the dynamic state of the liquid metal is then obtained by perturbing the oxygen distribution in the liquid and observing the dynamic response of the measured EMF of the detection cells. It is concluded that this novel technique holds considerable promise for use in a microgravity environment to detect low level flows and to accurately measure diffusivities. Furthermore, gravity driven convection in the melt prevents accurate measurement of the mass diffusivity of oxygen in metal systems by coulometric titration. This situation represents a clear example where a reduced gravity environment is necessary to obtain meaningful values of this important physical property.
Derived from text
Fluid Dynamics; Liquid Metals; Flow Visualization; Convective Flow; Diffusivity; Metal-Gas Systems; Oxygen Atoms; Dynamic Response; Electrochemical Cells; Nonintrusive Measurement

19990040261 Universities Space Research Association, Huntsville, AL USA
Step Bunching: Influence of Impurities and Solution Flow
Chernov, A. A., Universities Space Research Association, USA; Vekilov, P. G., Alabama Univ., USA; Coriell, S. R., National Inst.

of Standards and Technology, USA; Murray, B. T., National Inst. of Standards and Technology, USA; McFadden, G. B., National Inst. of Standards and Technology, USA; NASA Microgravity Materials Science Conference; February 1999, pp. 115-123; In English; See also 19990040241
Contract(s)/Grant(s): NAG8-1354; NAG8-1454; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

Step bunching results in striations even at relatively early stages of its development and in inclusions of mother liquor at the later stages. Therefore, eliminating step bunching is crucial for high crystal perfection. At least 5 major effects causing and influencing step bunching are known: (1) Basic morphological instability of stepped interfaces. It is caused by concentration gradient in the solution normal to the face and by the redistribution of solute tangentially to the interface which redistribution enhances occasional perturbations in step density due to various types of noise; (2) Aggravation of the above basic instability by solution flowing tangentially to the face in the same directions as the steps or stabilization of equidistant step train if these flows are antiparallel; (3) Enhanced bunching at supersaturation where step velocity v increases with relative supersaturation s much faster than linear. This v(s) dependence is believed to be associated with impurities. The impurities of which adsorption time is comparable with the time needed to deposit one lattice layer may also be responsible for bunching; (4) Very intensive solution flow stabilizes growing interface even at parallel solution and step flows; (5) Macrosteps were observed to nucleate at crystal corners and edges. Numerical simulation, assuming step-step interactions via surface diffusion also show that step bunching may be induced by random step nucleation at the facet edge and by discontinuity in the step density (a ridge) somewhere in the middle of a face. The corresponding bunching patterns produce the ones observed in experiment. The nature of step bunching generated at the corners and edges and by dislocation step sources, as well as the also relative importance and interrelations between mechanisms 1-5 is not clear, both from experimental and theoretical standpoints. Furthermore, several laws controlling the evolution of existing step bunches have been suggested, though unambiguous conclusions are still missing. Addressing these issues is the major goal of the present project. The theory addressing the above problem, experimental methods, several figures which include: (1) the spatial wave numbers at which the system is neutrally stable as a function of growth velocity for linear kinetics and supersaturation for nonlinear kinetics; (2) a schematic of the experiment of lysozyme crystal growing under conditions of natural convection; (3) fluctuations in time, t, of the normal growth rate, R(t), vicinal slope, p(t) and Fourier Spectra of R(t), discussions and conclusions are presented.
Derived from text
Crystal Growth; Bunching; Crystal Defects; Impurities; Morphology

19990040308 NASA Langley Research Center, Hampton, VA USA
Influence of Natural Convection and Thermal Radiation Multi-Component Transport in MOCVD Reactors
Lowry, S., CFD Research Corp., USA; Krishnan, A., CFD Research Corp., USA; Clark, I., NASA Langley Research Center, USA; NASA Microgravity Materials Science Conference; February 1999, pp. 399-405; In English; See also 19990040241
Contract(s)/Grant(s): NAS8-40846; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

The influence of Grashof and Reynolds number in Metal Organic Chemical Vapor (MOCVD) reactors is being investigated under a combined empirical/numerical study. As part of that research, the deposition of Indium Phosphide in an MOCVD reactor is modeled using the computational code CFD-ACE. The model includes the effects of convection, conduction, and radiation as well as multi-component diffusion and multi-step surface/gas phase chemistry. The results of the prediction are compared with experimental data for a commercial reactor and analyzed with respect to the model accuracy.
Author
Computational Fluid Dynamics; Free Convection; Grashof Number; Reynolds Number; Surface Reactions; Thermal Radiation; Navier-Stokes Equation; Metalorganic Chemical Vapor Deposition

19990040321 North Carolina Univ., Dept. of Mathematics, Chapel Hill, NC USA
A Phase-Field/Fluid Motion Model of Solidification: Investigation of Flow Effects During Directional Solidification and Dendritic Growth
Anderson, D. M., North Carolina Univ., USA; McFadden, G. B., National Inst. of Standards and Technology, USA; Boettinger, W. J., National Inst. of Standards and Technology, USA; Wheeler, A. A., Southampton Univ., UK; NASA Microgravity Materials Science Conference; February 1999, pp. 469-474; In English; See also 19990040241; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

The phase-field model of solidification is extended to include the effects of fluid flow in the melt. The phase-field model is based on coupling the equations for heat flow in the liquid and solid phases with an auxiliary equation that describes the evolution of the phase-field variable, which is a non-conserved order parameter indicating the local phase, solid or liquid, at each point of the material. The solid-liquid interface is then represented by a diffuse transition layer in which the phase-field variable changes rapidly between its values in the bulk phases. The model is extended to include fluid flow by a further coupling to the Navier-

Stokes equations. Preliminary studies have been performed for a model in which the solid phase is treated as a liquid of high viscosity compared to the liquid phase. The main coupling in the Navier-Stokes equations is then through an additional term in the stress tensor that depends on the gradients of the phase-field variable, representing the effects of capillary forces within the diffuse interface. We will apply this model to solidification and crystal growth situations in order to investigate the effect of fluid motion in the melt on the growth characteristics as well as the microstructure formed in the solid. In particular, we will study hydrodynamic effects during directional solidification, coarsening, and dendritic growth, where complicated interface morphologies and flows may be present. Finally we will extend the model to solidification of a binary alloy with fluid flow in the melt.
Derived from text
Mathematical Models; Crystal Growth; Directional Solidification (Crystals); Dendritic Crystals; Liquid-Solid Interfaces; Microstructure; Crystal Structure; Melts (Crystal Growth); Phase Separation (Materials); Fluid Flow

19990040349 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA USA
Dynamic Nucleation of Supercooled Melts and Measurement of the Surface Tension and Viscosity
Trinh, E. H., Jet Propulsion Lab., California Inst. of Tech., USA; Ohsaka, K., Jet Propulsion Lab., California Inst. of Tech., USA; NASA Microgravity Materials Science Conference; February 1999, pp. 629-634; In English; See also 19990040241; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

We investigate the phenomenon of acoustic pressure-induced nucleation by using a novel approach involving the large amplitude resonant radial oscillations and collapse of a single bubble intentionally injected into a supercooled liquid. Using a combination of previously developed and proven techniques, the bubble is suspended in a fluid host by an ultrasonic field which supplies both the levitation capability as well as the forcing of the radial oscillations. We observe the effects of an increase in pressure (due to bubble collapse) in a region no larger than 100 microns within the supercooled melt to rigorously probe the hypothesis of pressure-induced nucleation of the solid phase. The use of single bubbles operating in narrow temporal and spatial scales will allow the direct and unambiguous correlation between the origin and location of the generation of the disturbance and the location and timing of the nucleation event. In a companion research effort, we are developing novel techniques for the non-contact measurements of the surface tension and viscosity of highly viscous supercooled liquids. Currently used non-invasive methods of surface tension measurement for the case of undercooled liquids generally rely of the quantitative determination of the resonance frequencies of drop shape oscillations, of the dynamics of surface capillary waves, or of the velocity of streaming flows. These methods become quickly ineffective when the liquid viscosity rises to a significant value. An alternate and accurate method which would be applicable to liquids of significant viscosity is therefore needed. We plan to develop such a capability by measuring the equilibrium shape of levitated undercooled melt droplets as they undergo solid-body rotation. The experimental measurement of the characteristic point of transition (bifurcation point) between axisymmetric and two-lobed shapes will be used to calculate the surface tension of the liquid. Such an approach has already been validated through the experimental verification of numerical modeling results. The experimental approach involves levitation, melting, and solidification of undercooled droplets using a hybrid ultrasonic-electrostatic technique in both a gaseous as well as a vacuum environment. A shape relaxation method will be investigated in order to derive a reliable method to measure the viscosity of undercooled melts. The analysis of the monotonic relaxation to equilibrium shape of a drastically deformed and super-critically damped free drop has been used to derive interfacial tension of immiscible liquid combinations where one of the component has high viscosity. A standard approach uses the initial elongation of a droplet through shear flows, but an equivalent method could involve the initial deformation of a drop levitated in a gas by ultrasonic radiation pressure, electric stresses, or even solid body rotation. The dynamic behavior of the free drop relaxing back to equilibrium shape will be modeled, and its characteristic time dependence should provide a quantitative means to evaluate the liquid viscosity.
Derived from text
Bubbles; Collapse; Melts (Crystal Growth); Nucleation; Viscosity; Interfacial Tension; Ice

19990040421 Alabama Univ., Propulsion Research Center, Huntsville, AL USA
Injector Mixing Efficiency Experiments ***Final Report***
Moser, Marlow D., Alabama Univ., USA; Aug. 31, 1998; 27p; In English
Contract(s)/Grant(s): NAS8-38609
Report No.(s): NASA/CR-1999-208190; NAS 1.26:208190; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Various optical diagnostic techniques such as laser induce fluorescence, Raman spectroscopy, laser Doppler velocimetry, and laser light scattering have been employed to study the flowfield downstream of a single injector element in a optically accessible rocket chamber at Penn State for a number o years. These techniques have been used with both liquid and gaseous oxygen at pressures up to 1000 psia which is the limit of the facility. The purpose of the test programs at Penn State were to develop the techniques and to study the flow field from various injector designs. to extend these studies to higher pressure and ultimately to multiple injec-

tors require the capabilities of the Marshall Space Flight Center. These studies will extend the data base available for the various injector designs to higher pressure as well as to determine the interaction between multiple injectors. During this effort the Princeton Instruments ICCD camera was set up and checked out. The functionality of the system has been thoroughly checked and the shutter compensation time was found to be not working. The controller was returned to the manufacturer for warranty repair. The sensitivity has been measured and found to be approximately 60 counts per photon at maximum gain which agrees with the test data supplied by the manufacturer. The actual value depends on wavelength. The Princeton Instruments camera was been installed in a explosion proof tube for use with the rocket combustor. A 35 mm camera was also made ready for taking still photos inside the combustor. A fiber optic was used to transmit the laser light from an argon-ion laser to the rocket combustor for the light scattering images. This images were obtained for a LOX-hydrogen swirl coax injector. Several still photos were also obtained with the 35 mm camera for these firings.
Derived from text
Experimentation; Injectors; Combustion Chambers; Controllers; Flow Distribution; Fluorescence; Photographs; Thrust Chambers

19990040535 Department of Energy, Washington, DC USA
Study of flow patterns and dissolution kinetics in bubble columns
Long, R., Department of Energy, USA; Holbrook, S., Department of Energy, USA; Chang, T., Department of Energy, USA; Nov. 30, 1997; 25p; In English
Report No.(s): DE99-001036; LA-SUB-98-55; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
Research objectives were to: study liquid and gas phase flow patterns in a bubble column reactor by comparing observations made with reported observations and hydrodynamic models; study mixing of two miscible liquid solutions with and without solid suspension in a bubble column reactor; study the kinetics of dissolution of a reactive solid phase suspended in the liquid phase in a bubble column reactor; and calculate mass transfer coefficients and apparent reaction rate from suitable mathematical models. Observations and conclusions are summarized in a series of viewgraphs.
NTIS
Two Phase Flow; Chemical Reactors; Bubbles; Solid Suspensions; Mathematical Models; Solid Phases; Liquid Phases

19990040623 NASA Lewis Research Center, Cleveland, OH USA
Can Klebanoff Modes Produce Turbulent Spots?
Wundrow, D. W., NYMA, Inc., USA; Goldstein, M. E., NASA Lewis Research Center, USA; 1994; 24p; In English; No Copyright; Avail: Issuing Activity, Hardcopy, Microfiche
This note concerns the development of Klebanoff modes on a laminar flat-plate boundary layer subjected to free-stream turbulence. Using the results of an asymptotic analysis given in Goldstein, Leib, and Cowley (1992), we show that the Klebanoff modes can become nonlinear downstream of the leading edge even though the corresponding RMS velocity fluctuations are relatively small, say of the order of 10 percent of the free-stream velocity. The resulting nonlinear stage of development leads to a localized separation which may be related to turbulent spot formation.
Author
Laminar Boundary Layer; Boundary Layer Flow; Turbulence; Nonlinearity; Boundary Layer Equations; Mathematical Models; Incompressible Flow

19990040679 Bettis Atomic Power Lab., West Mifflin, PA USA
Measurements of interfacial area concentration in two-phase bubbly flow
Wu, Q.; Kim, S.; McCreary, D.; Ishii, M.; Beus, S. G.; Dec. 31, 1997; 6p; In English, 1997
Report No.(s): DE99-000477; WAPD-T-3178; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
Interfacial area concentration is an important parameter in the two-fluid model for two-phase flow analysis, which is defined as the total interface area per unit mixture volume and has the following local time-averaged expression: (bar a)(sup t) = 1/(Delta)T (Sigma)(sub j)(1/(vert-bar)V(sub i) (center-dot) n(sub i)(vert-bar))(sub j), where j denotes the j-th interface that passes the point of interest in a time interval (Delta)T. V(sub i) and n(sub i) refer to the bubble interface velocity and surface normal vector, respectively. To measure this parameter, the double-sensor probe technique is commonly used. Due to the influences of the bubble lateral motions, however, the measurement results should be interpreted via a certain statistic approach. Recently, to take into account the effects of the probe spacing, Wu and Ishii provided the following new formula to correlate the measurable values to the interfacial area concentration: (bar a)(sub i)(sup t) = 2N(sub b)/(Delta)T ((Delta)(bar t) /(Delta)s) (2 + (1.2(sigma)(sub (Delta)t)/(Delta)(bar t))(sup 2.25)), for D = 1.2 (approximately) 2.8 (Delta)s, where N(sub b) refers to the number of the bubbles that hit the probe front tip during time interval (Delta)T, (Delta)s denotes the distance between the two probe tips, D is the bubble

diameter, (Delta)(bar t) represents the measured average time interval for an interface to travel through the two probe tips, and (sigma)(sub (Delta)t) is the standard deviation of (Delta)t. The theoretical accuracy of this formula is within +/-5% if the sample size is sufficiently large. The purpose of this study is to evaluate this method experimentally using an image processing method.
NTIS
Two Phase Flow; Two Fluid Models; Bubbles

19990040962 CSA Engineering, Inc., Palo Alto, CA USA
Effect of Electrostatic Field on Film Rupture, *May 1997 - Jul. 1998*
Subba, Rama; Gorla, Reddy; Byrd, Larry W.; Sep. 1998; 25p; In English
Contract(s)/Grant(s): F33615-94-C-3200
Report No.(s): AD-A361177; ASIAC-TR-98-03; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The nonlinear thin film rupture has been analyzed by investigating the stability of thin films under the influence of electrostatic field to finite amplitude disturbances. The dynamics of the liquid film is formulated using the Navier Stokes equations including a body force term due to van der Waals attractions. The effect of the electric field is included in the analysis. The governing equation was solved by finite difference method as part of an initial value problem for spatial periodic boundary conditions. A discussion is provided for the effect of the electric field strength on the film rupture.
DTIC
Boundary Value Problems; Electric Field Strength; Electric Fields

19990041052 NASA Ames Research Center, Moffett Field, CA USA
Measurements of the Free-Stream Fluctuations above a Turbulent Boundary Layer
Wood, D. H., NASA Ames Research Center, USA; Westphal, R. V., NASA Ames Research Center, USA; Physics of Fluids; October 1988; Volume 31, No. 10, pp. 2834-2840; In English; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

In this paper an investigation of the velocity fluctuations in the free stream above an incompressible turbulent boundary layer developing at constant pressure is described. It is assumed that the fluctuations receive contributions from three statistically independent sources: (1) one-dimensional unsteadiness, (2) free-stream turbulence, and (3) the irrotational motion induced by the turbulent boundary layer. Measurements were made in a wind tunnel with a root-mean-square level of the axial velocity fluctuations of about 0.2%. All three velocity components were measured using an X-wire probe. The unsteadiness was determined from the spanwise covariance of the axial velocity fluctuations, measured using two single-wire probes. The results show that it is possible to separate the contributions to the rms level of the velocity fluctuations without resorting to the dubious technique of high-pass filtering. This separation could be extended to the spectral densities of the contributions if measurements of sufficient accuracy were available.
Author
Research; Turbulent Boundary Layer; Velocity; Flow Measurement; Free Flow

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INSTRUMENTATION AND PHOTOGRAPHY

Includes remote sensors; measuring instruments and gages; detectors; cameras and photographic supplies; and holography. For aerial photography see 43 Earth Resources and Remote Sensing. For related information see also 06 Aircraft Instrumentation, and 19 Space Instrumentation.

19990038383 Department of Energy, Office of Financial Management and Controller, Washington, DC USA
Uncooled thin film infrared imaging device with aerogel thermal insulation: Deposition and planarization techniques
Ruffner, J. A., Department of Energy, USA; Clem, P. G., Department of Energy, USA; Tuttle, B. A., Department of Energy, USA; Brinker, C. J., Department of Energy, USA; Iram, C. S., Department of Energy, USA; Apr. 30, 1998; 20p; In English; Thin Solid Filsm (TSF) and Surface and Coatings Technology (SCT), USA
Report No.(s): DE98-004623; SAND-98-0847C; CONF-980429; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The authors have successfully integrated a thermally insulating silica aerogel thin film into a new uncooled monolithic thin film infrared (IR) imaging device. Compared to other technologies (bulk ceramic and microBridge), use of an aerogel layer provides superior thermal isolation of the pyroelectric imaging element from the relatively massive heat sinking integrated circuit. This results in significantly higher thermal and temporal resolutions. They have calculated noise equivalent temperature differences of 0.04--0.10 C from a variety of Pb(x)Zr(y)Ti(1-y)O3 (PZT) and Pb(x)La(1-x)Zr(y)Ti(1-y)O3 (PLZT) pyroelectric imag-

ing elements in monolithic structures. In addition, use of aerogels results in an easier, less expensive fabrication process and a more robust device. Fabrication of these monolithic devices entails sol-gel deposition of the aerogel, sputter deposition of the electrodes, and solution chemistry deposition of the pyroelectric imaging elements. Uniform pyroelectric response is achieved across the device by use of appropriate planarization techniques. These deposition and planarization techniques are described. Characterization of the individual layers and monolithic structure using scanning electron microscopy, atomic force microscopy and Byer-Roundy techniques also is discussed.
NTIS
Thin Films; Infrared Imagery; Aerogels; Thermal Insulation; Deposition; Imaging Techniques

19990039091 Air Force Inst. of Tech., School of Engineering, Wright-Patterson AFB, OH USA
Optimization of a Multilayer Photothermal Sensor for Infrared Spectroscopy
Wiggins, Janine O.; Mar. 1999; 116p; In English
Report No.(s): AD-A361427; AFIT/GAP/ENP/99M-16; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche
Tri-layer thermal diffusion modeling was applied to the optimization of a multi-layer reed sensor for use in a photothermal infrared detector. The multi-layer reed sensor deflects in response to increased temperature. Deflection, of angstroms or larger, is measured using an atomic force microscope. A newly developed thermal diffusion model for three layer reeds was combined with an existing two-layer cantilever model, in order to explore the effects of length, operating frequency, and layer thickness on signal to noise ratio. Model behavior is presented, and compared to laboratory results.
DTIC
Infrared Detectors; Signal to Noise Ratios; Thermal Diffusion

19990039616 Department of Energy, Washington, DC USA
Long wavelength infrared camera (LWIRC): a 10 micron camera for the Keck Telescope
Wishnow, E. H., Department of Energy, USA; Danchi, W. C., Department of Energy, USA; Tuthill, P., Department of Energy, USA; Wurtz, R., Department of Energy, USA; Jernigan, J. G., Department of Energy, USA; May 01, 1998; 11p; In English; Astronomical Telescopes and Instrumentation, USA; Sponsored by International Society for Optical Engineering, USA
Report No.(s): DE98-056041; UCRL-JC-130643; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
The Long Wavelength Infrared Camera (LWIRC) is a facility instrument for the Keck Observatory designed to operate at the f/25 forward Cassegrain focus of the Keck I telescope. The camera operates over the wavelength band 7-13 (micro)m using ZnSe transmissive optics. A set of filters, a circular variable filter (CVF), and a mid-infrared polarizer are available, as are three plate scales: 0.05'', 0.10'', 0.21'' per pixel. The camera focal plane array and optics are cooled using liquid helium. The system has been refurbished with a 128 x 128 pixel Si:As detector array. The electronics readout system used to clock the array is compatible with both the hardware and software of the other Keck infrared instruments NIRC and LWS. A new pre-amplifier/A-D converter has been designed and constructed which decreases greatly the system susceptibility to noise.
NTIS
Telescopes; Cameras; Focal Plane Devices; Infrared Instruments; Cassegrain Optics

19990040207 California Inst. of Tech., Dept. of Electrical Engineering, Pasadena, CA USA
Optoelectronic Memory Interface ***Final Report, May - Nov. 1997***
Psaltis, Demetri; Feb. 1999; 14p; In English
Contract(s)/Grant(s): F30602-97-1-0204; DARPA ORDER-B667; AF Proj. B667
Report No.(s): AD-A361104; AFRL-IF-RS-TR-1999-22; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
Optoelectronic Memory Interface research involves comparing of read/write holographic memory module with silicon storage, magnetic storage on issue of cost, density, size and speed. With a photorefractive crystal on top of a silicon interface, the holographic memory is of cost efficiency, volume compactness, and fast data accessing. Key challenges to implement the competitive holographic memory are discussed in this report.
DTIC
Optoelectronic Devices; Memory (Computers)

19990040403 OptiMetrics, Inc., Ann Arbor, MI USA
Computational Vision Model (CVM) Research and Development ***Final Report, Mar. 1996 - 1998***
Lindquist, Goerge H.; Freeling, J. Richard; Dunstan, Allyn W.; Mar. 13, 1998; 60p; In English
Contract(s)/Grant(s): DAAE07-96-C-X053
Report No.(s): AD-A361237; OMI-612; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

In the present effort, we have built a new and improved model for the prediction of target acquisition. It is based on the latest models of early vision processes in the human visual system. It is a multi-channel model, based on three color opponent channels, and two temporal channels. Each channel is further subdivided into a set of multi-resolution channels. Computations are based on contrast ratio. Local energy values for these dimensionless contrast images are computed, and normalized by the sum of eye noise and clutter. The detectability metric is then computed from these energies. This model has been applied to the problem of detecting cars approaching intersections, and to the detection of mobile ground targets in imagery taken from an airborne first generation FLIR system. Reasonably good correlations were obtained. Several alternative studies were also undertaken, along with a critique, in hindsight, of the ideas and philosophy used in the development of the model.
DTIC
Target Acquisition; FLIR Detectors; Image Contrast

19990040493 ManTech Systems Engineering Corp., Greenbelt, MD USA
Small-Scale Digital Photogrammetry in a Cryogenic Vacuum Environment
Pazar, Richard E., ManTech Systems Engineering Corp., USA; 20th Space Simulation Conference: The Changing Testing Paradigm; February 1999, pp. 333-340; In English; See also 19990040464; No Copyright; Avail: CASI; A02, Hardcopy; A03, Microfiche

A thermal vacuum test fixture was designed, built, tested and operated to position and protect a digital photogrammetry camera in a thermal vacuum chamber. The purpose of the work was to determine the mechanical deformations of the MAP (Microwave Anisotropy Probe) spacecraft as it was cooled from ambient temperature (2930 Kelvin) to approximately 201 Kelvin. This paper describes the reasoning and methodology that were used to create the machine.
Author
Vacuum Chambers; Digital Cameras; Test Facilities; Photogrammetry; Test Equipment

19990040636 Royal Netherlands Meteorological Inst., De Bilt, Netherlands
Comparison of Vaisala's HMP233 and HMP243 Relative Air Humidity Meters, *Feb. - Sep. 1997 Vergelijking van de Vaisala's HMP233 en HMP243 Relatieve Luchtvochtigheidsmeters*
Kuik, F., Royal Netherlands Meteorological Inst., Netherlands; 1997; ISSN 0169-1708; In Dutch
Report No.(s): KNMI-TR-201; ISBN 90-369-2131-7; Copyright; Avail: Issuing Activity (KNMI, P.O. Box 201, 3730 AE De Bilt, Wilhelminalaan 10, The Netherlands), Hardcopy, Microfiche

For some years the KNMI has used Vaisala HMP233 sensors for measuring the relative air humidity (RI4). When compared to sensors that were used before the HMP233, the HMP233 provides excellent performance, and there have been few complaints or significant problems. However, in 1996 the Royal Air Force stated that in when freezing temperatures are paired with relative air humidity above 90%, the HMP233 perhaps is not completely reliable. This determination was based on two factors. The first was that observers of the KLu compared visual observations with measurements of the RH originating from the HMP233. When they visually observed that the visibility was increasing, it appeared that the RH (measured with the HMP233) ultimately decreased but that there was a delay with regard to the visual observations.
Author
Freezing; Humidity

19990040665 NASA Goddard Space Flight Center, Greenbelt, MD USA
Preventing Molecular and Particulate Infiltration in a Confined Volume
Scialdone, John J., NASA Goddard Space Flight Center, USA; 1999; 8p; In English, 18 Jul. 1999, USA; Sponsored by International Society for Optical Engineering, USA; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Contaminants from an instrument's self-generated sources or from sources external to the instrument may degrade its critical surfaces and/or create an environment which limits the instrument's intended performance. Analyses have been carried out on a method to investigate the required purging flow of clean, dry gas to prevent the ingestion of external contaminants into the instrument container volume. The pressure to be maintained and the required flow are examined in terms of their effectiveness in preventing gaseous and particulate contaminant ingestion and abatement of self-generated contaminants in the volume. The required venting area or the existing volume venting area is correlated to the volume to be purged, the allowable pressure differential across the volume, the external contaminant partial pressure, and the sizes of the ambient particulates. The diffusion of external water vapor into the volume while it was being purged was experimentally obtained in terms of an infiltration time constant. That data and the acceptable fraction of the outside pressure into the volume indicate the required flow of purge gas expressed in terms of volume change per unit time. The exclusion of particulates is based on the incoming velocity of the particles and the exit flow speed and density of the purge gas. The purging flow pressures needed to maintain the required flows through the vent passages

are indicated. The purge gas must prevent or limit the entrance of the external contaminants to the critical locations of the instrument. It should also prevent self- contamination from surfaces, reduce material outgassing, and sweep out the outgassed products. Systems and facilities that can benefit from purging may be optical equipment, clinical facilities, manufacturing facilities, clean rooms, and other systems requiring clean environments.
Author
Confinement; Contamination; Gas Flow; Infiltration; Optical Equipment; Outgassing; Purging; Water Vapor; Molecular Absorption

19990040668 NASA Goddard Space Flight Center, Greenbelt, MD USA
Modeling the Performance of Direct-Detection Doppler Lidar Systems in Real Atmospheres
McGill, Matthew J., NASA Goddard Space Flight Center, USA; Hart, William D., Science Systems and Applications, Inc., USA; McKay, Jack A., Remote Sensor Concepts, USA; Spinhirne, James D., NASA Goddard Space Flight Center, USA; March 1999; 33p; In English; Original contains color illustrations; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Previous modeling of the performance of spaceborne direct-detection Doppler lidar systems has assumed extremely idealized atmospheric models. Here we develop a technique for modeling the performance of these systems in a more realistic atmosphere, based on actual airborne lidar observations. The resulting atmospheric model contains cloud and aerosol variability that is absent in other simulations of spaceborne Doppler lidar instruments. to produce a realistic simulation of daytime performance, we include solar radiance values that are based on actual measurements and are allowed to vary as the viewing scene changes. Simulations are performed for two types of direct-detection Doppler lidar systems: the double-edge and the multi-channel techniques. Both systems were optimized to measure winds from Rayleigh backscatter at 355 nm. Simulations show that the measurement uncertainty during daytime is degraded by only about 10-20% compared to nighttime performance, provided a proper solar filter is included in the instrument design.
Author
Atmospheric Models; Satellite Instruments; Backscattering; Aerosols; Doppler Radar; Performance Prediction

19990040720 Naval Air Warfare Center, Photogrammetry Branch, Patuxent River, MD USA
NAWCAD Photogrammetrics: Methods and Applications for Aviation Test and Evaluation
Williams, James W., Naval Air Warfare Center, USA; Stancil, Robert F., Naval Air Warfare Center, USA; Forsman, Alec E., Naval Air Warfare Center, USA; Aircraft Weapon System Compatibility and Integration; April 1999, pp. 8-1 - 8-6; In English; See also 19990040714; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

Photogrammetry using multiple sequential recorded film and video images has been an integral part of flight test and evaluation at the Naval Air Warfare Center Aircraft Division (NAWCAD) at Patuxent River, MD for nearly 40 years. Photogrammetric analysis is used for evaluation of stores separation, carrier suitability, ballistic trajectory tracking, overhead impact scoring, and mishap reconstruction. NAWCAD, Patuxent River, MD recently began flight testing for the F/A-18 E/F development program. The initial phase of the weapons separation portion of the F/A-18E/F development program is a 13 month project consisting of two aircraft flying 256 flights during which 2000 stores will be dropped. To meet the challenge of processing high volumes of photogrammetric data and delivering solution within 72 hours of each flight, the NAWCAD Photogrammetric Team initiated strategies to reduce the time, increase the volume of data analysis, and increase the accuracies of solution processes that historically have been labor intensive and difficult to present. The NAWCAD Photogrammetric Team is developing an image enhancement and data analysis system, and an on-line database which will provide near real-time access and retrievability of test data. This paper describes how NAWCAD scientists have applied a clearly defined process for photogrammetric efforts, implemented state-of-the-art hardware and software methodologies, and architecture that reduce the turnaround time, reduce the cost, increase the accuracy, and facilitate the delivery of custom formatted products to the flight test engineer.
Author
Photogrammetry; Systems Compatibility; External Store Separation; Ballistic Trajectories; Flight Tests; Data Processing

19990040786 Brookhaven National Lab., Upton, NY USA
Construction of a high resolution crystal backscattering spectrometer HERMES I
Larese, J. Z.; Dec. 31, 1998; 150p; In English
Report No.(s): DE99-000909; BNL-65873; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

There is a need in the USA for a state-of-the-art, cold-neutron, crystal backscattering spectrometer (CBS) designed to investigate the structure and dynamics of condensed matter systems by the simultaneous utilization of long wavelength elastic diffraction and high-energy-resolution inelastic scattering. Cold neutron spectroscopy with CBS-type instruments has already made many important contributions to the study of atomic and molecular diffusion in biomaterials, polymers, semiconductors, liquid crystals, superionic conductors and the like. Such instruments have also been invaluable for ultra high resolution investigations of the low-lying quantum tunneling processes that provide direct insight into the dynamical response of solids at the lowest energies. Until relatively recently, however, all such instruments were located at steady-state reactors. This proposal describes HERMES I (High Energy Resolution Machines I) a CBS intended for installation at the LANSCE pulsed neutron facility of Los Alamos National Laboratory. As explained in detail in the main text, the authors propose to construct an updated, high- performance CBS which incorporates neutron techniques developed during the decade since IRIS was built, i.e., improved supermirror technology, a larger area crystal analyzer and high efficiency wire gas detectors. The instrument is designed in such a way as to be readily adaptable to future upgrades. HERMES I, they believe, will substantially expand the range and flexibility of neutron investigations in the USA and open new and potentially fruitful directions for condensed matter exploration. This document describes a implementation plan with a direct cost range between $4.5 to 5.6 M and scheduled duration of 39--45 months for identified alternatives.
NTIS
Construction; High Resolution; Backscattering; Neutron Spectrometers; Liquid Crystals

19990040870 Oak Ridge National Lab., TN USA
Hardware implementation of the ORNL fissile mass flow monitor
McEvers, J.; Sumner, J.; Jones, R.; Ferrell, R.; Martin, C.; Dec. 31, 1998; 6p; In English; 39th; Institute of Nuclear Materials Management (INMM) annual meeting
Report No.(s): DE99-000223; ORNL/CP-99171; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
This paper provides an overall description of the implementation of the Oak Ridge National Laboratory (ORNL) Fissile Mass Flow Monitor, which is part of a Blend Down Monitoring System (BDMS) developed by the US Department of Energy (DOE). The Fissile Mass Flow Monitor is designed to measure the mass flow of fissile material through a gaseous or liquid process stream. It consists of a source-modulator assembly, a detector assembly, and a cabinet that houses all control, data acquisition, and supporting electronics equipment. The development of this flow monitor was first funded by DOE/NE in September 95, and an initial demonstration by ORNL was described in previous INMM meetings. This methodology was chosen by DOE/NE for implementation in November 1996, and the hardware/software development is complete. Successful BDMS installation and operation of the complete BDMS has been demonstrated in the Paducah Gaseous Diffusion Plant (PGDP), which is operated by Lockheed Martin Utility Services, Inc. for the US Enrichment Corporation and regulated by the Nuclear Regulatory Commission. Equipment for two BDMS units has been shipped to the Russian Federation.
NTIS
Mass Flow; Fissionable Materials; Monitors; Mixtures

19990040871 Oak Ridge National Lab., TN USA
Calibration measurements using the ORNL fissile mass flow monitor
March-Leuba, J.; Uckan, T.; Sumner, J.; Mattingly, J.; Mihalczo, J.; Dec. 31, 1998; 6p; In English; 39th; Meeting sponsored in part by Institute of Nuclear Materials Management
Report No.(s): DE99-000222; ORNL/CP-99170; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
This paper presents a demonstration of fissile-mass-flow measurements using the Oak Ridge National Laboratory (ORNL) Fissile Mass Flow Monitor in the Paducah Gaseous Diffusion Plant (PGDP). This Flow Monitor is part of a Blend Down Monitoring System (BDMS) that will be installed in at least two Russian Federation (R.F.) blending facilities. The key objectives of the demonstration of the ORNL Flow Monitor are two: (a) demonstrate that the ORNL Flow Monitor equipment is capable of reliably monitoring the mass flow rate of (235)UF6 gas, and (b) provide a demonstration of ORNL Flow Monitor system in operation with UF6 flow for a visiting R.F. delegation. These two objectives have been met by the PGDP demonstration, as presented in this paper.
NTIS
Calibrating; Mass Flow; Fissionable Materials; Flow Measurement; Monitors

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LASERS AND MASERS

Includes parametric amplifiers. For related information see also 76 Solid-State Physics.

19990038377 Department of Energy, Office of Energy Research, Washington, DC USA
Periscope pop-in beam monitor
Johnson, E. D., Department of Energy, USA; Graves, W. S., Department of Energy, USA; Robinson, K. E., Department of Energy, USA; Jun. 30, 1998; 8p; In English; 8th; Beam Instrumentation (BIW-98), USA
Report No.(s): DE98-007242; BNL-65651; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The authors have built monitors for use as beam diagnostics in the narrow gap of an undulator for an Free Electron Lasers (FEL) experiment. They utilize an intercepting screen of doped YAG scintillating crystal to make light that is imaged through a periscope by conventional video equipment. The absolute position can be ascertained by comparing the electron beam position with the position of a He:Ne laser that is observed by this pop-in monitor. The optical properties of the periscope and the mechanical arrangement of the system mean that beam can be spatially determined to the resolution of the camera, in this case approximately 10 micrometers. The experience with these monitors suggests improvements for successor designs, which they also describe.
NTIS
Periscopes; Beams (Radiation); Monitors; Electron Beams

19990039086 Air Force Inst. of Tech., Wright-Patterson AFB, OH USA
Kinetic Model of a Space-Based, Br(4 (2)P 1/2 to 4 (2)P 3/2) Laser Pumped by Solar Photolysis of IBr
Behnken, Barry N.; Mar. 1999; 177p; In English
Report No.(s): AD-A361441; AFIT/GAP/ENP/99M-01; No Copyright; Avail: Issuing Activity (Defense Technical Information Center (DTIC)), Microfiche

A kinetic model of the directly solar-pumped, atomic bromine laser-operating on the Br(4 (2)P 1/2 to (2)P 3/2) transition under IBr photolysis-was developed, executed, and interpreted. In recognition of an evolving national interest in space-based laser development, the model presumed operation on a space station platform. Results indicate that a well-engineered IBr laser is capable of generating 1.2 kilowatts of continuous-wave (CW) power under a pumping concentration of 20,000 solar units. Such performance translates to an efficiency of roughly 0.29%, appreciably better than the 0.1% ascribed to the heretofore leading solar-pumped competitor. An extensive analysis of kinetic data suggests the unanticipated conclusion that, under proper parameter selection, sustained CW oscillation can be achieved absent any flow mechanism whatsoever. This result seems most strongly predicated upon proper bandpass discrimination: a 457-545 nm range of incidence produced optimal results. Sensitivity analysis revealed a strong degree of competition among the laser's constituent processes; two-body quenching and exchange reactions were predominant. With the significant exception of iodine recombination, three-body processes were negligible. Thermal increases, as well as rapid growth of atomic iodine, appear to pose the greatest kinetic threat to CW lasing.
DTIC
Kinetics; Space Stations; Bromine; Lasers; Solar Energy; Photolysis; Laser Pumping; Iodine Compounds

19990039087 Air Force Inst. of Tech., Wright-Patterson AFB, OH USA
A Continuous Wave Atomic Bromine Laser Produced by Photolysis of Iodine Monobromide
Smith, Brian A.; Mar. 09, 1999; 33p; In English
Report No.(s): AD-A361438; AFIT/GAP/ENP/99M-12; No Copyright; Avail: Issuing Activity (Defense Technical Information Center (DTIC)), Microfiche

An apparatus to generate continuous wave (CW) lasing at 2.714 mm by Br(2P 1/2) atoms produced from photodissociation of IBr was designed, constructed and tested. A frequency doubled Nd:YAG laser firing 8 ns, 850 mJ pulses at 532 nm was used to photodissociate static IBr vapor inside a flow nozzle. The CaF2 windows on either side of the nozzle proved to have a damage threshold below the threshold for lasing. Pulsed lasing in static mode was not observed. Therefore, CW lasing in flow mode, using an Ar+ laser at 488 nm, could not be investigated.
DTIC
Continuous Wave Lasers; Atoms; Bromine; Photolysis; Iodine

19990039094 Air Force Inst. of Tech., School of Engineering, Wright-Patterson AFB, OH USA
Laser Beam Combining and Cleanup via Stimulated Brillouin Scattering in Multi-mode Optical Fibers
Rodgers, Blake C.; Mar. 1999; 92p; In English

Report No.(s): AD-A361422; AFIT/GAP/ENP/99M-09; No Copyright; Avail: Issuing Activity (Defense Technical Information Center (DTIC)), Microfiche

The main objective of this thesis was to demonstrate the feasibility of combining and cleaning up multiple laser beams via Stimulated Brillouin Scattering (SBS) in a multi-mode optical fiber. Beam combining via SBS in an optical fiber is of interest because of the low SBS threshold power in an optical fiber allowing low power diode laser beams to be combined into one high power beam. SBS theory and some of the important historical results are described briefly. The experimental results clearly indicate that SBS in multi-mode optical fiber can indeed combine laser beams and clean up the beams at the same time. Both single-pass and ring-cavity geometries were used successfully. The SBS threshold power for the 9.5 micron diameter fiber was 26.5 +/- 0.5 mW for a single-pass setup and 19.7 +/- 0.5 mW for a ring-cavity setup. The SBS power conversion slope efficiency was measured to be 42% for the single-pass setup and 52% for the ring-cavity setup. The SBS signal exhibited both periodic oscillations and random amplitude fluctuations, which are believed to be due to low levels of power used for the experiment. The polarization of the SBS signal was the same as the input laser beam.

DTIC

Laser Beams; Brillouin Effect; Scattering; Optical Fibers; Cleaning

19990039197 Department of Energy, Office of Energy Research, Washington, DC USA

Bandgap renormalization studies of n-type GaAs/AlGaAs single quantum wells

Jones, E. D., Department of Energy, USA; Blount, M., Department of Energy, USA; Chow, W., Department of Energy, USA; Hou, H., Department of Energy, USA; Simmons, J. A., Department of Energy, USA; Sep. 30, 1997; 6p; In English; 24th; Compound Semiconductors, USA

Report No.(s): DE98-000225; SAND-97-1083C; CONF-970947; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Bandgap energy renormalization due to many body effects has been studied in a series of n-type 8-nm-wide GaAs/AlGaAs single quantum wells using magnetoluminescence spectroscopy at 1.4 K. The 2D-carrier densities varied between 1 and 12 x 10(exp 11)/sq cm. At the maximum 2D-carrier density, the bandgap energy reduction compared to an undoped specimen was found to be about 34 meV.

NTIS

Gallium Arsenides; Aluminum Gallium Arsenides; Quantum Wells; Research; Energy Gaps (Solid State)

19990039544 Air Force Research Lab., Human Effectiveness Directorate, Brooks AFB, TX USA

Infrared Lasers and Millimeter Waves: The Links Between Microwaves and Laser Optics ***Interim Report, 21 - 22 Jan. 1997***

Adair, Eleanor R.; Feb. 1999; 457p; In English; Presented at Infrared Lasers and Millimeter Waves Workshop, The Links Between Microwaves and Laser Optics, at Brooks AFB, TX., on 21-22 Jan 97.

Contract(s)/Grant(s): Proj-7757

Report No.(s): AD-A361483; AFRL-HE-BR-PC-1999-0002; No Copyright; Avail: CASI; A20, Hardcopy; A04, Microfiche

The goal of this project is to reconcile the guidelines for human exposure at the frequency interface (300 GHz) between millimeter waves and infrared lasers and to derive means for this reconciliation in terms of existing and proposed scientific data requirements. to this end, a two-day workshop was convened at Brooks Air Force Base on 21-22 January 1997 at which experts in the technology and biological effects of exposure to both millimeter wave frequencies and infrared laser optics presented papers on the state of the art in their respective disciplines. Several informal discussions and a final panel discussion illuminated the key questions requiring answers and proposed research that would help define these answers. A significant step toward future refinement of the exposure guidelines was the establishment of a six-person ad hoc committee, under the Chairmanship of Dr. Kenneth R. Foster, to serve as a liaison between radio frequency and infrared laser standards-setting organizations. This committee would determine research and modeling needs that would provide the basis, in terms of both field strength and averaging time, for a reconciled exposure guideline for humans at 300 GHz.

DTIC

Millimeter Waves; Infrared Lasers; Radiation Hazards; Biological Effects; Radio Frequencies

19990039628 Department of Energy, Washington, DC USA

Blast wave diagnostic for the petawatt laser system

Budil, K., Department of Energy, USA; Jun. 03, 1998; 18p; In English

Report No.(s): DE98-058593; UCRL-JC-130955; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

We report on a diagnostic to measure the trajectory of a blast wave propagating through a plastic target 400 micro-m thick. This blast wave is generated by the irradiation of the front surface of the target with approximately 400 J of 1 micro-m laser radi-

ation in a 20 ps pulse focused to a approximately 50 micro-m diameter spot, which produces an intensity in excess of 10(exp 18) W/sq cm. These conditions approximate a point explosion and a blast wave is predicted to be generated with an initial pressure nearing 1 Gbar which decays as it travels approximately radially outward from the interaction region We have utilized streaked optical pyrometry of the blast front to determine its time of arrival at the rear surface of the target Applications of a self-similar Taylor-Sedov blast wave solution allows the amount of energy deposited to be estimated The experiment, LASNEX design simulations and initial results are discussed.
NTIS
Laser Beams; Detonation Waves; Shock Waves; Irradiation; Explosions

19990040217 Naval Research Lab., Washington, DC USA
Propagation of Short Laser Pulses in Plasma Channels ***Interim Report***
Sprangle, P.; Hafizi, B.; Serafim, P.; Mar. 02, 1999; 37p; In English
Contract(s)/Grant(s): NRL/MR/6790--99-8321
Report No.(s): AD-A361320; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Finite pulse length effects are shown to play a major role in the propagation, stability and guiding of intense laser beams in plasmas. We present the quasi paraxial approximation (QPA) to the wave equation that takes finite pulse length effects into account. The QPA is an extension of the usual paraxial approximation. The laser field is shown to be significantly modified for pulses less than a few tens of wavelengths long. A pair of coupled envelope-power equations having finite pulse length effects, as well as relativistic and atomic electron nonlinearities, is derived and analyzed. Short laser pulses propagating in plasma channels are found to undergo an envelope oscillation in which the front of the pulse is always damped while the back initially grows. The modulation eventually damps due to frequency spread phase mixing. In addition, finite pulse length effects are shown to significantly modify nonlinear focusing processes.
DTIC
Laser Beams; Wave Equations; Pulsed Lasers; Plasmas (Physics); Laser Outputs

19990040220 City Coll. Research Foundation, New York, NY USA
Organic Ultrafast Nonlinear Optical Devices Characterization of Organic Photonic Materials ***Final Report, 1 Mar. 1997 - 28 Feb. 1998***
Dorsinville, Roger; Feb. 04, 1999; 5p; In English
Contract(s)/Grant(s): F49620-97-1-0115
Report No.(s): AD-A361347; RF-447376-FR; AFRL-SR-BL-TR-99-0095; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

We have purchased and installed a new tunable femtosecond (150 fs) laser system dedicated to nonlinear optical characterization of organic materials. We have conducted the first nonlinear optical measurements of a thin film endohedral metallofullerene, Gd2
DTIC
Nonlinear Optics; Optical Measurement; Thin Films; Nonlinearity; Optical Equipment

19990040546 NASA Goddard Space Flight Center, Greenbelt, MD USA
Low-Cost, Single-Frequency Sources for Spectroscopy using Conventional Fabry-Perot Diode Lasers
Duerksen, Gary L., Maryland Univ., USA; Krainak, Michael A., NASA Goddard Space Flight Center, USA; 1999; 4p; In English; Advanced Semiconductor Lasers, 21-23 Jul. 1999, USA; Sponsored by Institute of Electrical and Electronics Engineers, USA; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

Commercial (uncoated) Fabry-Perot laser diodes are converted to single-frequency spectroscopy sources by passively locking the laser frequency to the band edge of a fiber Bragg grating, which phase-locks the laser oscillations through self-injection seeding.
Author
Semiconductor Diodes; Lasers; Laser Beams; Light Sources

19990040758 Naval Research Lab., Washington, DC USA
Plasma and X-UV Source Characteristics for Al Targets Heated by 40 Nsec Nd-laser Pulses
Whitlock, Robert R.; Nagel, David J.; Topscher, Stephen J.; Greig, J. R.; Mar. 16, 1999; 39p; In English
Report No.(s): AD-A361317; NRL/MR/6685--99-8338; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The total laser energy (3-32 J), temporal history (40 nsec FWHM) and focal energy distribution (3-10(exp 13) W/sq cm peak, 1.5 x 10(exp 13) W/sq cm average) for lambda = 1.06 microns Nd:glass laser interactions with planar Al targets were measured. Laser-produced plasma emissions within the 10 eV - 3 keV ultraviolet and x-ray range were recorded. Primary emphasis was given to obtaining the dependence of kilovolt x-ray emission on irradiance (varied by altering the energy on target or the lens-target spacing). A maximum efficiency for conversion of incident laser energy to radiation above 1.5 keV was 0.25% into 2 pi sr. Emitted x-ray intensity over this range of photon energy was found to increase as the 3.2 power of laser energy at best focus. X-ray emission decreased when a prepulse preceded the main pulse by a controlled amount exceeding 0.2 microseconds but less than 5 microseconds, with a minimum emission at 0.5 microseconds separation. Plasma temperatures were estimated from x-ray line intensity ratios and continuum slopes: a value near 230 eV was obtained from free-bound continuum slope for 3 x 10(exp 13) W/cu cm peak irradiance. Temperatures decreased at lower irradiances, as inferred from x-ray line ratios. This report covers systematic experimental measurements of laser plasma x-ray output. The work formed the basis for the later demonstration of microlithography with this same x-ray source, in support of the NRL patent for laser plasma x-ray lithography. The patent was licensed by a 100-person startup company, Hampshire Instruments, Inc., who offered a technically viable method to achieve submicron critical linewidths for the production of integrated circuits.
DTIC
Ultraviolet Radiation; Electromagnetic Interactions; Incident Radiation; Plasmas (Physics); Integrated Circuits

19990040790 Argonne National Lab., Advanced Photon Source Div., IL USA
Potential diagnostics for the next-generation light sources
Lumpkin, A. H.; Yang, B. X.; Dec. 31, 1998; 14p; In English; 20th; Free electron laser, 1998
Report No.(s): DE98-058860; ANL/ASD/CP-96517; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

There is continued interest in developing a diffraction-limited soft or hard x-ray source. Candidate paths include the storage-ring-based free-electron laser (FEL) and the linac-based self-amplified spontaneous emission (SASE) FEL for the two regimes, respectively. The authors report the use of few- to sub-angstrom radiation emitted by a 7 GeV beam transmitting a 198 period diagnostics undulator and a bending magnet to characterize the particle beam. A particle beam divergence as low as sigma(sub y(prime)) = 3.3 microrad was measured using an x-ray monochromator. Additionally, a particle beam size of sigma(sub y) less than 45 micrometers and a bunch length of sigma(sub t) = 28 ps with 4 ps resolution were measured using an x-ray pinhole camera with a unique synchroscan and dual-sweep x-ray streak camera as the detector. The adjustable pinhole aperture was varied by more than a factor of 100 to assess spatial resolution and dynamic range issues in the system. These diagnostics demonstrations should scale to next-generation applications.
NTIS
Diagnosis; Light Sources

19990040793 Sandia National Labs., Albuquerque, NM USA
Intracavity frequency doubling of an optically-pumped, external-cavity surface-emitting semiconductor laser
Alford, W. J.; Raymond, T. D.; Crawford, M. H.; Allerman, A. A.; Dec. 31, 1998; 4p; In English; Advanced Solid State Laser
Report No.(s): DE99-001124; SAND-98-2108C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The authors have produced milliwatts of blue light from a diode-pumped, multiple-quantum-well semiconductor laser. This compact source has a pump-to- blue optical efficiency greater than 1%.
NTIS
Semiconductor Lasers; Laser Cavities; Optical Pumping; Quantum Efficiency; Quantum Well Lasers

19990040825 Lawrence Livermore National Lab., Livermore, CA USA
Stress wave focusing transducers
Visuri, S. R.; May 15, 1998; 6p; In English; Sponsored by Optical Society of America, USA
Report No.(s): DE98-058848; UCRL-JC-130697; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Conversion of laser radiation to mechanical energy is the fundamental process behind many medical laser procedures, particularly those involving tissue destruction and removal. Stress waves can be generated with laser radiation in several ways: creation of a plasma and subsequent launch of a shock wave, thermoelastic expansion of the target tissue, vapor bubble collapse, and ablation recoil. Thermoelastic generation of stress waves generally requires short laser pulse durations and high energy density. The stress wave due to thermoelastic expansion travels at the sound speed (approximately 1500 m/s in tissue) and leaves the site of irradiation well before subsequent thermal events can be initiated. These stress waves, often evolving into shock waves, can be used to disrupt tissue. Shock waves are used in ophthalmology to perform intraocular microsurgery and photodisruptive proce-

dures as well as in lithotripsy to fragment stones. We have explored a variety of transducers that can efficiently convert optical to mechanical energy. One such class of transducers allows a shock wave to be focused within a material such that the stress magnitude can be greatly increased compared to conventional geometries. Some transducer tips could be made to operate regardless of the absorption properties of the ambient media. The size and nature of the devices enable easy delivery, potentially minimally-invasive procedures, and precise tissue-targeting while limiting thermal loading. The transducer tips may have applications in lithotripsy, ophthalmology, drug delivery, and cardiology.
NTIS
Stress Waves; Focusing; Transducers

19990040862 Argonne National Lab., IL USA
Numerical study of the 3-D effect on FEL performance and its application to the APS LEUTL FEL
Chae, Y. C.; Dec. 31, 1998; 2p; In English; 20th; Free Electron Laser, 1998
Report No.(s): DE98-058862; ANL/ASD/CP-96443; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

A Low-Energy Undulator Test Line (LEUTL) is under construction at the Advanced Photon Source (APS). In LEUTL, periodic focusing is provided by external quadrupoles. This results in an elliptical beam with its betatron oscillation envelope varying along the undulators. The free-electron laser (FEL) interaction with such a beam will exhibit truly 3-D effects. Thus the investigation of 3-D effects is important in optimizing the FEL performance. The programs GINGER and TDA3D, coupled with theoretically known facts, have been used for this purpose. Both programs are fully 3-D in moving the particle, but model the interaction between particles and axially symmetric electromagnetic waves. Even though TDA3D can include a few azimuthal modes in the interaction, it is still not a fully 3-D FEL code. However, they show that these 2-D programs can still be used for an elliptical beam whose aspect ratio is within certain limits. The author presents numerical results of FEL performance for the circular beam, the elliptical beam, and finally for the beam in the realistic LEUTL lattice.
NTIS
Free Electron Lasers; Numerical Analysis

19990040863 Argonne National Lab., Advanced Photon Source Div., IL USA
Optical techniques for electron-beam characterizations on the APS SASE FEL project
Lumpkin, A. H.; Yang, B. X.; Berg, W. J.; White, M.; Lewellen, J. W.; Dec. 31, 1998; 15p; In English; 20th; Free Electron Laser, 1998
Report No.(s): DE98-058861; ANL/ASD/CP-96526; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

At the Advanced Photon Source (APS) the injector linac's DC thermionic gun is being supplemented by a low-emittance Radio Frequencies (rf) thermionic gun that will support the SASE FEL project. to address the anticipated smaller beam sizes, the standard Chromox beam-profiling screens are being complemented by optical transition radiation (OTR) and Ce-doped YAG single-crystal converters. Direct comparisons of the effective conversion efficiency, spatial resolution, and time response of the three converter screen types have been performed using the DC thermionic gun's beam accelerated to 400 to 650 MeV. An apparent blurring of observed beam size with increasing incident charge areal density in the YAG crystal was observed for the first time. Only the OTR was prompt enough for the few-ps domain micropulse bunch length measurements performed with a stream camera. Initial beam images of the rf-thermionic gun beam have also been obtained.
NTIS
Optical Transition; Electron Beams; Free Electron Lasers

19990040953 Department of Energy, Washington, DC USA
Design modeling of the 100-J diode-pumped solid-state laser for Project Mercury
Orth, C.; Feb. 23, 1998; 19p; In English; BIOS '98: Biomedical optics
Report No.(s): DE98-058766; UCRL-JC-127934; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

We present the energy, propagation, and thermal modeling for a diode-pumped solid-state laser called Mercury being designed and built at LLNL using Yb:S- FAP i.e., Yb(sup 3+)-doped SR5PO4(3)F crystals for the gain medium. This laser is intended to produce 100 J pulses at 1 to 10 ns at 10 Hz with an electrical efficiency of approximately 10%. Our modeling indicates that the laser will be able to meet its performance goals.
NTIS
Diodes; Solid State Lasers; Design Analysis; Mathematical Models; Optical Pumping

19990040956 Department of Energy, Washington, DC USA

Hard x-ray production from high intensity laser solid interactions

Sefcik, J.; Jun. 03, 1998; 13p; In English; 12th; High-temperature plasma diagnostics

Report No.(s): DE98-058753; UCRL-JC-130942; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Intense laser (> 10(exp 21) W/cm(exp 2)) driven hard x-ray sources offer a new alternative to conventional electron accelerator bremsstrahlung sources. These laser driven sources offer considerable simplicity in design and cost advantage for multiple axis views and have the potential for much higher spatial and temporal resolution than is achievable with accelerator sources We have begun a series of experiments using the Petawatt Laser system at LLNL to determine the potential of these sources for radiography applications Absolutely calibrated spectra extending to 20 MeV and high resolution radiographs through a (rho)r(>=)150 gm/cm(exp 2) have been obtained The physics of these sources and the scaling relationships and laser technology required to provide the dose levels necessary for radiography applications will be discussed Diagnostics of the laser produced electrons and photons will be addressed

NTIS

High Power Lasers; X Ray Sources; Electromagnetic Interactions

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MECHANICAL ENGINEERING

Includes auxiliary systems (nonpower); machine elements and processes; and mechanical equipment.

19990039138 Department of Energy, Office of Financial Management and Controller, Washington, DC USA

Hinged-pad test structure for sliding friction measurement in micromachining

Boer, M. P., Department of Energy, USA; Redmond, J. M., Department of Energy, USA; Michalske, T. A., Department of Energy, USA; Dec. 31, 1998; 9p; In English; Micromachining and Microfabrication, USA

Report No.(s): DE98-007268; SAND-98-1759C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The authors describe the design, modeling, fabrication and initial testing of a new test structure for friction measurement in MEMS. The device consists of a cantilevered forked beam and a friction pad attached via a hinge. Compared to previous test structures, the proposed structure can measure friction over much larger pressure ranges, yet occupies one hundred times less area. The placement of the hinge is crucial to obtaining a well-known and constant pressure distribution in the device. Static deflections on the device were measured and modeled numerically, Preliminary results indicate that friction pad slip is sensitive to friction pad normal force.

NTIS

Test Facilities; Miniaturization; Sliding Friction; Friction Measurement; Micromachining; Fabrication; Microelectromechanical Systems

19990039657 NASA Lewis Research Center, Cleveland, OH USA

Life of Pennzane and 815Z-Lubricated Instrument Bearings Cleaned with Non-CFC Solvents

Loewenthal, Stuart, Lockheed Martin Missile and Space, USA; Jones, William, NASA Lewis Research Center, USA; Predmore, Roamer, NASA Goddard Space Flight Center, USA; September 1999; 19p; In English; 8th; European Space Mechanisms and Tribology, 29 Sep. - 1 Oct. 1999, Toulouse, France

Contract(s)/Grant(s): NAS5-50000; RTOP 442-458-60-80-08; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report takes the form of two papers: (1) ”Life of Pennzane and 815Z-Lubricated Instrument Bearings cleaned with Non-CFC Solvents” and (2) a published paper, entitled ”Instrument bearing life with NON-CFC cleaners”. Abstract for paper # 1 : Bearings used in spacecraft mechanisms have historically been cleaned with chlorofluorocarbon CFC-1 13 (Freon) solvents and lubricated with a perfluorinated polyalkylether (PFPE) oils like 815-Z. Little full-scale bearing life test data exists to evaluate the effects of the newer class environmental-friendly bearing cleaners or improved synthetic hydrocarbon space oils like Pennzane. to address the lack of data, a cooperative, bearing life test program was initiated between NASA, Lockheed Martin and MPB. The objective was to obtain comparative long-term, life test data for flight-quality bearings, cleaned with non-CFC solvents versus CFC-1 13 under flight-like conditions with two space oils. A goal was to gain a better understanding of the lubricant surface chemistry effects with such solvents. A second objective was to obtain well-controlled, full-scale bearing life test data with a relatively

new synthetic oil (Pennzane), touted as an improvement to Bray 815Z, an oil with considerable space flight history. The second paper, which serves as an attachment, is abstracted below: Bearings used in spacecraft mechanisms have historically been cleaned with chlorofluorocarbon CFC-113 (Freon) solvents and lubricated with a perfluorinated polyalkylether (PFPE) oils like 815-Z. Little full-scale bearing life test data exists to evaluate the effects of the newer class environmental-friendly bearing cleaners or improved synthetic hydrocarbon space oils like Pennzane. to address the lack of data, a cooperative, bearing life test program was initiated between NASA, Lockheed Martin and MPB. The objective was to obtain comparative long-term, life test data for flight-quality bearings, cleaned with non-CFC solvents versus CFC-1 13 under flight-like conditions with two space oils. A goal was to gain a better understanding of the lubricant surface chemistry effects with such solvents. A second objective was to obtain well-controlled, full-scale bearing life test data with a relatively new synthetic oil (Pennzane), touted as an improvement to Bray 815Z, an oil with considerable space flight history.
CASI
Freon; Lubricants; Solvents; Bearings; Lubrication Systems; Chlorofluorocarbons

19990040340 Pennsylvania State Univ., Applied Research Lab., University Park, PA USA
Preliminary Investigation on the Effects of Gravity on Welding Behavior of a 304 Stainless Steel
Kang, Nam Hyun, Pennsylvania State Univ., USA; Howell, Paul R., Pennsylvania State Univ., USA; Singh, Jogender, Pennsylvania State Univ., USA; Lambrakos, Samuel G., Naval Research Lab., USA; Marsh, Steven P., Naval Research Lab., USA; NASA Microgravity Materials Science Conference; February 1999, pp. 575-580; In English; See also 19990040241; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

Welding processes have been utilized widely throughout industry because of their being cost-effective and easy to employ in an assembly process. However, welding in space needs to be understood more precisely during melting and solidification, because it is difficult to precisely control the operating conditions. The important parameters which control the weld quality and shape are the interacting convection forces of a melt within the weld-pool. Three major forces for convection in laser welding are: gravity driven buoyancy flow, surface tension gradient driven thermocapillary flow, and concentration gradient driven flow. Lorentz flow driven by electromagnetic forces must also be considered for convection in gas tungsten arc welding(GTAW). Considerable research has been conducted to understand the effects of various convection forces, and mathematical models have been developed to validate the experimental result that surface tension gradient driven flow is the dominant force in normal earth gravity of 1 g. However, few welding experiments have been performed to understand the effects of microgravity on microstructural behavior and the weld-pool shape. In addition, different results have been reported depending on the welding material and operating parameters. For example, the Soviet's electron beam welding experiments on stainless steel, Al and Ti samples reported that weightlessness did not significantly affect the welding depth. Japan's GTAW of Al and 2219 Al alloy was performed under microgravity conditions; the weld bead in microgravity contained none of the ripple lines which normally exist in 1 g welds. In the KC-135 laser welding experiments of a stainless steel, the weld depth increased and more ripple lines were observed in microgravity than in the welds at 1 g. The ultimate objective of the present investigation is to study the effect of heat/mass transfer in welding behavior as a function of gravitational force. The effects of gravitational force on the GTAW will be discussed for a 304 stainless steel that was produced by the KC- 135 aircraft experiment at NASA.
Derived from text
Microgravity; Gravitational Effects; Convection; Gas Tungsten Arc Welding; Weld Strength; Heat Transfer; Mass Transfer

19990040481 NASA Marshall Space Flight Center, Huntsville, AL USA
Atomic Oxygen Effects on Seal Leakage
Christensen, John R., Boeing Defense and Space Group, USA; Underwood, Steve D., Boeing Defense and Space Group, USA; Kamenetzky, Rachel R., NASA Marshall Space Flight Center, USA; Vaughn, Jason A., NASA Marshall Space Flight Center, USA; 20th Space Simulation Conference: The Changing Testing Paradigm; February 1999, pp. 195-206; In English; See also 19990040464; No Copyright; Avail: CASI; A03, Hardcopy; A03, Microfiche

Common Berthing Mechanism (CBM provides the structural interface between separate International Space Station (ISS) elements, such as the Laboratory and Node modules. The CBM consists of an active and a passive half that join together with structural bolts. The seal at this interface is the CBM-to-CBM molded seal. The CBM-to-CBM interface is assembled on orbit, thus the seals can be exposed to the space environment for up to 65 hours. Atomic Oxygen/Vacuum Ultraviolet radiation (AO/VUV) in space is a potential hazard to the seals. Testing was conducted to determine the effect on leakage of the CBM-to-CBM seal material exposed to AO/VUV. The sealing materials were S383 silicone and V835 fluorocarbon material. Control samples, which were not exposed to the AO/VUV environment, were used to ensure that ff any changes in leakage occurred, they could

be attributed to the AO/VUV exposure. After exposure to the AO/VUV environment the leakage increase was dramatic for the fluorocarbon. This testing was a major contributing factor in selecting silicone as the CBM-to-CBM seal material.
Author
Aerospace Environments; International Space Station; Leakage; Nuclear Radiation; Sealing; Ultraviolet Radiation; Oxygen Atoms; Earth Orbital Environments; O Ring Seals

19990040664 NASA Marshall Space Flight Center, Huntsville, AL USA
Chattering-Free Sliding Mode Control with Unmodeled Dynamics
Krupp, Don, NASA Marshall Space Flight Center, USA; Shtessel, Yuri B., Alabama Univ., USA; 1999; 6p; In English; American Control, 2-4 Jun. 1999, San Diego, CA, USA; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Sliding mode control systems are valued for their robust accommodation of uncertainties and their ability to reject disturbances. In this paper, a design methodology is proposed to eliminate the chattering phenomenon affecting sliding mode controlled plants with input unmodeled actuator dynamics of second order or greater. The proposed controller design is based on the relative degrees of the plant and the unmodeled actuator dynamics and the ranges of the uncertainties of the plant and actuator. The controller utilizes the pass filter characteristics of the physical actuating device to provide a smoothing effect on the discontinuous control signal rather than introducing any artificial dynamics into the controller design thus eliminating chattering in the system's output response.
Author
Technology Assessment; Design Analysis; Controllers

19990040815 Department of Energy, Office of Energy Research, Washington, DC USA
Stability of a pendant droplet in gas metal arc welding
Murray, P. E., Department of Energy, USA; Dec. 31, 1998; 6p; In English; 5th; Trends in Welding Research, USA
Report No.(s): DE98-057367; INEEL/CON-98-00695; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The authors develop a model of metal transfer in gas metal arc welding and compute the critical mass of a pendant droplet in order to ascertain the size and frequency of droplets detaching from the consumable metal electrode. These results are used to predict the mode of metal transfer for a range of voltage and current encompassing free flight transfer, and the transition between globular and spray transfer. This model includes an efficient method to compute the stability of a pendant droplet and the location of the liquid Bridge connecting the primary droplet and the residual liquid remaining after detachment of the primary droplet.
NTIS
Rods; Mathematical Models; Arc Welding; Electric Potential; Electrodes; Critical Mass

19990041087 NASA Lewis Research Center, Cleveland, OH USA
Influence of Gear Design on Gearbox Radiated Noise
Oswald, Fred B., NASA Lewis Research Center, USA; Townsend, Dennis P., NASA Lewis Research Center, USA; Valco, Mark J., Army Research Lab., USA; Spencer, Robert H., Boeing Helicopter Co., USA; Drago, Raymond J., Boeing Helicopter Co., USA; Lenski, Joseph W., Jr., Boeing Helicopter Co., USA; Gear Technology; Jan.-Feb. 1998, pp. 10-15; In English
Contract(s)/Grant(s): NAS3-25421; No Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

A major source of helicopter cabin noise (which has been measured at over 100 decibels sound pressure level) is the gearbox. Reduction of this noise is a NASA and U.S. Army goal. A requirement for the Army/NASA Advanced Rotorcraft Transmission project was a 10 dB noise reduction compared to current designs The main exciting forces which produce gear noise are the meshing forces of the gear teeth in the transmission. While many factors influence transmission noise, the simple fact remains that if the basic exciting forces are reduced and no amplifying factors are present, the overall noise level of the system will be reduced. Among the several ways in which the gear tooth meshing forces may be reduced, two of the most directly applicable to helicopter transmissions are the form of the teeth and the overall contact ratio. Nine different spur and helical gear designs were tested in the NASA gear-noise rig to compare the noise radiated from the gearbox top for the various gear designs. Sound power measurements were made under controlled conditions for a matrix of opening conditions.
Derived from text
Acoustic Measurement; Aircraft Noise; Gear Teeth; Noise Reduction; Transmissions (Machine Elements)

38
QUALITY ASSURANCE AND RELIABILITY

Includes product sampling procedures and techniques; and quality control.

19990039208 Department of Energy, Office of Financial Management and Controller, Washington, DC USA
Survey of probabilistic methods used in reliability, risk and uncertainty analysis: Analytical techniques 1
Robinson, D. G., Department of Energy, USA; Jun. 30, 1998; 36p; In English
Report No.(s): DE98-005788; SAND-98-1189; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

This report provides an introduction to the various probabilistic methods developed roughly between 1956--1985 for performing reliability or probabilistic uncertainty analysis on complex systems. This exposition does not include the traditional reliability methods (e.g. parallel-series systems, etc.) that might be found in the many reliability texts and reference materials (e.g. and 1977). Rather, the report centers on the relatively new, and certainly less well known across the engineering community, analytical techniques. Discussion of the analytical methods has been broken into two reports. This particular report is limited to those methods developed between 1956--1985. While a bit dated, methods described in the later portions of this report still dominate the literature and provide a necessary technical foundation for more current research. A second report (Analytical Techniques 2) addresses methods developed since 1985. The flow of this report roughly follows the historical development of the various methods so each new technique builds on the discussion of strengths and weaknesses of previous techniques. to facilitate the understanding of the various methods discussed, a simple 2-dimensional problem is used throughout the report. The problem is used for discussion purposes only; conclusions regarding the applicability and efficiency of particular methods are based on secondary analyses and a number of years of experience by the author. This document should be considered a living document in the sense that as new methods or variations of existing methods are developed, the document and references will be updated to reflect the current state of the literature as much as possible. For those scientists and engineers already familiar with these methods, the discussion will at times become rather obvious. However, the goal of this effort is to provide a common basis for future discussions and, as such, will hopefully be useful to those more intimate with probabilistic analysis and design techniques. There are clearly alternative methods of dealing with uncertainty (e.g. fuzzy set theory, possibility theory), but this discussion will be limited to those methods based on probability theory.
NTIS
Systems Analysis; Probability Theory; Reliability Analysis; Complex Systems

19990040422 Alabama Univ., Huntsville, AL USA
Study Methods to Standardize Thermography NDE *Final Report*
Walker, James L., Alabama Univ., USA; Workman, Gary L., Alabama Univ., USA; February 1998; 84p; In English
Contract(s)/Grant(s): NAS8-38609
Report No.(s): NASA/CR-1999-208189; NAS 1.26:208189; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

The purpose of this work is to develop thermographic inspection methods and standards for use in evaluating structural composites and aerospace hardware. Qualification techniques and calibration methods are investigated to standardize the thermographic method for use in the field. Along with the inspections of test standards structural hardware, support hardware is designed and fabricated to aid in the thermographic process. Also, a standard operating procedure is developed for performing inspections with the Bales Thermal Image Processor (TIP). Inspections are performed on a broad range of structural composites. These materials include graphite/epoxies, graphite/cyanide-ester, graphite/silicon-carbide, graphite phenolic and Kevlar/epoxy. Also metal honeycomb (titanium and aluminum faceplates over an aluminum honeycomb core) structures are investigated. Various structural shapes are investigated and the thickness of the structures vary from as few as 3 plies to as many as 80 plies. Special emphasis is placed on characterizing defects in attachment holes and bondlines, in addition to those resulting from impact damage and the inclusion of foreign matter. Image processing through statistical analysis and digital filtering is investigated to enhance the quality and quantify the NDE thermal images when necessary.
Author
Research; Thermography; Nondestructive Tests; Procedures; Inspection; Standardization; Structural Design; Statistical Analysis

19990040473 Boeing Defense and Space Group, International Space Station Program, Huntsville, AL USA
Structural Weld Leak Testing in Support of the International Space Station Node 1, Airlock and Laboratory Flight Elements
Underwood, Steve, Boeing Defense and Space Group, USA; Holt, Angela, Boeing Defense and Space Group, USA; 20th Space Simulation Conference: The Changing Testing Paradigm; February 1999, pp. 105-111; In English; See also 19990040464; No

Copyright; Avail: CASI; A02, Hardcopy; A03, Microfiche

Developmental testing on the detector probe method of helium leak detection was performed in support of the International Space Station program (ISS) at Marshall Space Flight Center (MSFC), in Huntsville AL. The test evaluated detector probe sniffing techniques, head designs, optimum sizes and linear head speeds used to detect a known leak approximately IE-4 accs helium. The test resulted in detector probe head design and fabrication for leak testing pressurized vessel external surfaces, and also in the development of the detector probe head design and test procedure used to test all structural welds on Node 1, Airlock, and Laboratory flight elements. In support of the ISS structural weld leak test, a helium mixing test was performed to evaluate the helium mixing method required to obtain a uniform helium concentration during testing of these modules, as a known helium concentration is necessary to accurately determine leak rates. Testing was performed in a 2500 cubic foot pressure vessel located at MSFC. Mixing fans were positioned internal to the pressure vessel, and oxygen sensors were mounted in the vessel top, middle and bottom areas in order to evaluate helium concentrations. The vessel was pressurized to 14.7 psig with 100% helium, vented to atmospheric pressure, pressurized back to 14.7 psig helium then vented back to atmospheric pressure. The test demonstrated that a uniform helium concentration can be obtained without mixing fans, and resulted in the elimination of oxygen monitors and mixing fans in the flight articles during weld and seal leak tests. The leak tests of the structural welds on the ISS Node 1, Airlock, and Laboratory flight elements were successfully completed in 1996 and 1997.

Author

Gas Detectors; Gas Pressure; Helium; Leakage; Pressure Vessels; Weld Tests; Welded Joints; Defects; Identifying

19990040487 European Space Agency. European Space Research and Technology Center, ESTEC, Noordwijk, Netherlands

The ESA/ESTEC Environmental Test Centre's New Quality Assurance System

Brinkmann, Peter W., European Space Agency. European Space Research and Technology Center, ESTEC, Netherlands; Panicucci, Massimo, European Space Agency. European Space Research and Technology Center, ESTEC, Netherlands; 20th Space Simulation Conference: The Changing Testing Paradigm; February 1999, pp. 269-284; In English; See also 19990040464; No Copyright; Avail: CASI; A03, Hardcopy; A03, Microfiche

During 1997, the ESA/ESTEC Environmental Test Centre underwent a major re-organization, entrusting the responsibilities for maintenance and operation to an industrial consortium. As a consequence, the quality system had to be adapted to the new organizational structure and to the new allocation of tasks and responsibilities. After introducing the Test Centre and its facilities, the paper describes the new management structure and the modified quality system. In particular it addresses the interfaces between ESA/ESTEC and the industrial consortium and summarizes the transition from the previous structure to the new organisation, during which activities and facilities were formally handed over to the consortium. It concludes with a preliminary assessment of the restructuring process.

Author

European Space Agency; Quality Control; Test Facilities; Research Management; Management

19990040661 NASA Marshall Space Flight Center, Huntsville, AL USA

The Effect of Penetration Depth on Thermal Contrast of NDT by Thermography

Chu, Tsuchin Philip, University of Southern Illinois, USA; DiGregorio, Anthony, University of Southern Illinois, USA; Russell, Samuel S., NASA Marshall Space Flight Center, USA; 1999; 3p; In English, 22 Mar. 1999, Orlando, FL, USA; Sponsored by American Society for Nondestructive Testing, Inc., USA; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

Nondestructive evaluation by Thermography (TNDE) is generally classified into two categories, the passive approach and the active approach. The passive approach is usually performed by measuring the natural temperature difference between the ambient and the material or structure to be tested. The active approach, on the other hand, requires the application of an external energy source to stimulate the material for inspection. A laser, a heater, a hot air blower, a high power thermal pulse, mechanical, or electromagnetic energy may provide the energy sources. For the external heating method to inspect materials for defects and imperfection at ambient temperature, a very short burst of heat can be introduced to one of the surfaces or slow heating of the side opposite to the side being observed. Due to the interruption of the heat flow through the defects, the thermal images will reveal the defective area by contrasting against the surrounding good materials. This technique is called transient Thermography, pulse video Thermography, or thermal wave imaging. As an empirical rule, the radius of the smallest defect should be at least one to two times larger than its depth under the surface. Thermography is being used to inspect void, debond, impact damage, and porosity in composite materials. It has been shown that most of the defects and imperfection can be detected. However, the current method of inspection using thermographic technique is more of an art than a practical scientific and engineering approach. The success rate of determining the defect location and defect type is largely depend on the experience of the person who operates thermography system and performs the inspection. The operator has to try different type of heat source, different duration of its application time, as well as experimenting with the thermal image acquisition time and interval during the inspection process.

Further-more, the complexity of the lay-up and structure of composites makes it more difficult to determine the optimal operating condition for revealing the defects. In order to develop an optimal thermography inspection procedure, we must understand the thermal behavior inside the material subjected to transient heat in order to interpret the thermal images correctly. Fabrication of finite element models of characteristic defects in composite materials subjected to transient heat will enable the development of appropriate procedure for thermography inspection. Design of phantom defects could be modeled and behavior characterized prior to physically building these test parts. Since production of phantom test parts can be very time consuming and laborious, it is important to design good representative defects.
Derived from text
Thermography; Nondestructive Tests; Defects; Depth; Heat Transmission; Inspection; Penetration; Temperature Effects; Thermal Mapping

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STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; and thermal stress. For applications see 05 Aircraft Design, Testing and Performance and 18 Spacecraft Design, Testing and Performance.

19990038378 Department of Energy, Washington, DC USA
Novel approach to penetrator calculations
Budge, K. G., Department of Energy, USA; Dec. 31, 1998; 5p; In English
Report No.(s): DE98-007161; SAND-98-0318C; CONF-981009; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The author presents a novel method for calculating the penetration of soft targets by hard projectiles by using a combination of ALE and contact surface techniques. This method allows the bifurcation in the softer material (at the point of the projectile) to be represented without sacrificing the Lagrangian representation of either the harder material or the contact interface. A series of calculations using this method show good agreement with the experimental data of Forrestal et al. This method may prove useful for a range of semi-fluid/structure interactions with friction, including simulations of manufacturing processes.
NTIS
Penetration; Computation

19990038385 National Aerospace Lab., Amsterdam Netherlands
Residual Strength Test on Stiffened Panels With Multiple-Site Damage ***Final Report***
TenHoeve, H. J.; Schra, L.; Michielsen, A. L.; Vlieger, H.; Feb. 1999; 77p; In English
Report No.(s): AD-A361537; NLR-CR-96792-L; DOT/FAA/AR-98/53; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

In Federal Aviation Administration and the Netherlands Department of Civil Aviation (FAA/RLD) collaboration, residual strength tests were carried out on stiffened panels with multiple-site damage (MSD). The main purpose of this test program was to generate experimental data to verify tools to predict the residual strength of such panels. In this report these tests are described and the results are presented in such a way that they can be used to verify new and existing models.
DTIC
Civil Aviation; Damage; Panels; Residual Strength; Tensile Tests

19990039209 Department of Energy, Office of Financial Management and Controller, Washington, DC USA
Development and validation of nondestructive inspection techniques for composite doubler repairs on commercial aircraft
Roach, D., Department of Energy, USA; Walkington, P., Department of Energy, USA; May 31, 1998; 170p; In English
Report No.(s): DE98-005803; SAND-98-1014; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Composite doublers, or repair patches, provide an innovative repair technique which can enhance the way aircraft are maintained. Instead of riveting multiple steel or aluminum plates to facilitate an aircraft repair, it is possible to bond a single boron-epoxy composite doubler to the damaged structure. In order for the use of composite doublers to achieve widespread use in the civil aviation industry, it is imperative that methods be developed which can quickly and reliably assess the integrity of the doubler. In this study, a specific composite application was chosen on an L-1011 aircraft in order to focus the tasks on application and operation issues. Primary among inspection requirements for these doublers is the identification of disbonds, between the composite laminate and aluminum parent material, and delaminations in the composite laminate. Surveillance of cracks or corrosion in the

parent aluminum material beneath the doubler is also a concern. No single nondestructive inspection (NDI) method can inspect for every flaw type, therefore it is important to be aware of available NDI techniques and to properly address their capabilities and limitations. A series of NDI tests were conducted on laboratory test structures and on full-scale aircraft fuselage sections. Specific challenges, unique to bonded composite doubler applications, were highlighted. An array of conventional and advanced NDI techniques were evaluated. Flaw detection sensitivity studies were conducted on applicable eddy current, ultrasonic, X-ray and thermography based devices. The application of these NDI techniques to composite doublers and the results from test specimens, which were loaded to provide a changing flaw profile, are presented in this report. It was found that a team of these techniques can identify flaws in composite doubler installations well before they reach critical size.
NTIS
Composite Materials; Procedures; Nondestructive Tests; Aircraft Maintenance; Boron-Epoxy Composites; Proving

19990039567 Defence Research Establishment Atlantic, Dartmouth, Nova Scotia Canada
High Frequency Response of a Ring-Stiffened Cylinder
Gilroy, L. E.; Smith, M. J.; Jan. 1998; 41p; In English
Report No.(s): AD-A361243; DREA-TM-98/221; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Power Flow Finite Element Analysis (PFFEA) has been under development at Defence Research Establishment Atlantic (DREA) in support of the Ship Noise Project. PFFEA is an analysis method for predicting high frequency structural acoustic and vibration response. The method is based on a vibrational conductivity approach in which the flow of vibrational energy is modelled in a similar fashion to heat conduction with convective losses. This report discusses experiments performed with DREA's 3m ring-stiffened cylinder to assist in the validation of the PFFEA software for high frequency structural vibrations. The experiments involved excitation of the cylinder structure at relatively high frequencies using an electromagnetic/piezoelectric shaker located on either the cylinder shell or one of the ring-stiffeners. Both the input power and the response of the cylinder were measured with both harmonic and broadband excitation using an accelerometer. The power flow predictions for either input mobility (harmonic case) or input power (broadband case) did not correlate well with the measured data. The measured applied forces were used as input to predict the response of the cylinder to both harmonic and broadband excitation. Not unexpectedly, the predicted harmonic response did not compare favourably with the measured values in the frequency ranges dominated by modal behaviour; however, predictions were better at the higher frequencies where the response is not modal. The broadband predictions were more accurate for both locations of the shaker. The 1/3-octave band predictions were more accurate for the shaker on the shell and for both locations the results were better at high frequencies.
DTIC
Vibration; Acoustics; Cylindrical Bodies; Program Verification (Computers); Harmonic Excitation; Frequency Ranges; Conductive Heat Transfer; High Frequencies; Noise (Sound)

19990039597 Department of Energy, Office of Environmental Restoration and Waste Management, Washington, DC USA
Model for predicting damage dependent response of inelastic media with microstructure
Allen, D. H., Department of Energy, USA; DeVries, K. L., Department of Energy, USA; Hurtado, L. D., Department of Energy, USA; Dec. 31, 1997; 24p; In English, USA
Report No.(s): DE98-001367; SAND-97-2707C; CONF-980902; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

This paper presents a model developed for predicting the mechanical response of inelastic media with heterogeneous microstructure. Particular emphasis is given to the development of microstructural damage along grains. The model is developed within the concepts of continuum mechanics, with special emphasis on the development of internal boundaries in the continuum by utilizing fracture mechanics-based cohesive zone models. In addition, the grains are assumed to be characterized by nonlinear viscoplastic material behavior. Implementation of the model to a finite element computational algorithm is also briefly described, and example solutions are obtained. Finally, homogenization procedures are discussed for obtaining macroscopic damage dependent mechanical constitutive equations that may then be utilized to construct a well-posed boundary value problem for the macroscopically homogenized damage dependent medium.
NTIS
Mathematical Models; Damage; Microstructure

19990040492 Air Force Research Lab., Space Vehicles Directorate, Kirkland AFB, NM USA
Simulated Space Debris Impact Experiments on Toughened Laminated Thin Solar Cell Cover Glass
Roybal, Robert, Air Force Research Lab., USA; Tlomak, Pawel, Air Force Research Lab., USA; Stein, Charles, Air Force Research Lab., USA; Stokes, P. H., Defence Research Agency, UK; 20th Space Simulation Conference: The Changing Testing

Paradigm; February 1999, pp. 323-331; In English; See also 19990040464; No Copyright; Avail: CASI; A02, Hardcopy; A03, Microfiche

Increasing demands on the design criteria of space craft components have driven efforts to develop advanced space debris ground simulation techniques suitable to be incorporated into a space environmental effects chamber. A laser driven flyer method suitable in such a chamber was used to conduct an initial investigation of space debris impact on a new toughened solar cell coverglass material. Damage characteristics, including mechanical damage and contamination generated by impact with a 3 mm diameter, 3 micron thick aluminum particle accelerated to 4.5 km/s, were looked at. Scanning electron microscopy, optical microscopy, and spectrophotometry were used to measure the mechanical damage and the loss of solar transmission. Because of the limited number of impact tests made in this initial study a quantitative analysis was not possible. However, much insight was obtained from the observed damage.

Author

Aerospace Environments; Impact Damage; Impact Tests; Solar Cells; Space Debris; Earth Orbital Environments; Low Earth Orbits; Polar Orbits; Experiment Design; Glass

19990040494 Aerospace Corp., El Segundo, CA USA

Hypervelocity Meteorite Impact Simulation

Ben-Shmuel, Shmuel, Aerospace Corp., USA; Goldstein, Selma, Aerospace Corp., USA; 20th Space Simulation Conference: The Changing Testing Paradigm; February 1999, pp. 341-354; In English; See also 19990040464; No Copyright; Avail: CASI; A03, Hardcopy; A03, Microfiche

A model has be= created for the numerical simulation of a penetrator particle impacting a plate at very high velocities. The analysis was conducted with the finite element hydrocode, LS-DYNA3D. The model attempts to predict the consequences of a meteorite particle hitting a spacecraft in orbit. Results show that the breakup mechanism of the penetrating particle is highly dependent on the magnitude of the impact velocity relative to the elastic wave velocity (speed of sound) of the penetrator's material. The analysis concentrates on understanding the physics of hypervelocity impact and the importance of parameters such as relative particle and plate sizes, impact velocity, particle shape, and impact angle. Modeling of material properties in the high strain rate plastic regune needs to be augmented and verified with pertinent experimental data. Additional codes may be required for analysis capabilities absent in LS-DYNA3D such as thermal modeling and tracking of the debris cloud generated by the breakup of particle and plate.

Author

Finite Element Method; Meteorite Collisions; Impact Velocity; Simulation; Spacecraft Shielding; Meteoroid Protection; Space Debris

19990040590 Department of Energy, Office of Financial Management and Controller, Washington, DC USA

Pretest Fracture Evaluation of the NESC-1 Spinning-Cylinder Experiment

Keeney, J. A., Department of Energy, USA; Bass, B. R., Department of Energy, USA; Williams, P. T., Department of Energy, USA; Pugh, C. E., Department of Energy, USA; Dec. 31, 1997; 9p; In English; Pressure Vessel and Piping (PVP), 1998, USA

Report No.(s): DE98-001895; ORNL/CP-95835; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

This paper describes a pretest fracture analysis of the cylinder specimen being used in the Network for Evaluating Steel Components (NESC) large-scale spinning-cylinder project (NESC-1). Organized as an international forum to exchange information on procedures for structural integrity assessment, to collaborate on specific projects, and to promote the harmonization of international standards, the NESC is currently focusing on a research project funded by UK Health and Safety Executive (HSE) to study the total process of structural integrity assessments of aged reactor pressure vessels (RPVs) containing subclad cracks. The intent is to have the problem studied by a wide range of organizations involved in RPV safety assessment. In this project, important safety assessment issues are being investigated by inspection and analysis of a spinning cylinder test which was performed at the AEA Technology facility at Risley, UK. Thermoelastic-plastic analyses were carried out for a clad cylinder model with a 74-mm-deep through-clad inner-surface crack. For this loading, the analytical results indicate that cleavage initiation may be achieved. The intervention of warm prestressing and loss of constraint may make cleavage initiation difficult to achieve in the heat-affected zone (HAZ) and near-HAZ regions.

NTIS

Cracking (Fracturing); Crack Propagation; Fracture Mechanics; Surface Cracks; Structural Failure; Steels

19990041059 Office National d'Etudes et de Recherches Aerospatiales, Paris, France

Theoretical and Numerical Approach for Vibrations of Structures Induced by Pyrotechnic Shocks ***Etude Theorique et Numerique des Vibrations de Structures Soumises a des Chocs Pyrotechniques***

Saied, Didier, Office National d'Etudes et de Recherches Aerospatiales, France; 1998; ISSN 0078-3780; 238p; In French; Original contains color illustrations

Report No.(s): ONERA-NT-1998-12; No Copyright; Avail: CASI; A11, Hardcopy; A03, Microfiche

This work deals with the vibratory prediction induced by pyrotechnic shocks in the stage separation of the Arione 5 launcher and specially in the Equipment Case. A simplified method is developed to determine the dynamic response of structures from the calculation of exact dynamic stiffness, This approach is reserved to waveguide structures in which the direction of wave propagation is known. Connections between structures are also considered; it is possible to determine dynamic stiffness of connections from the waves reflection and transmission coefficients and the force-displacement relationships in the elements connected to the connection.

Author

Numerical Analysis; Data Acquisition; Experimentation; Vibration; Wave Propagation

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GEOSCIENCES (GENERAL)

19990040642 Geological Survey, Reston, VA USA

Loma Prieta, California, Earthquake of October 17, 1989. Earth Structures and Engineering Characterization of Ground Motion

Holzer, T. L.; 1998; 90p; In English

Report No.(s): PB99-129975; USGS-PP-1552-D; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

Contents include the following: Introduction; Performance of earth dams during the Loma Prieta earthquake; Analysis of soil-nailed excavations stability during the 1989 Loma Prieta earthquake; Empirical analysis of peak horizontal acceleration, peak horizontal velocity, and modified mercalli intensity; and Attenuation of vertical and horizontal response spectra of the Loma Prieta earthquake.

NTIS

Earthquake Damage; Seismic Waves

19990040784 Society for Industrial and Applied Mathematics, Philadelphia, PA USA

Mathematical and computational issues in the geosciences: Final program and abstracts

Dec. 31, 1997; 79p; In English; 4th; Meeting sponsored in part by SIAM

Report No.(s): DE99-000995; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The conference focused on computational and modeling issues in the geosciences. of the geosciences, problems associated with phenomena occurring in the earth's subsurface were best represented. Topics in this area included petroleum recovery, ground water contamination and remediation, seismic imaging, parameter estimation, upscaling, geostatistical heterogeneity, reservoir and aquifer characterization, optimal well placement and pumping strategies, and geochemistry. Additional sessions were devoted to the atmosphere, surface water and oceans. The central mathematical themes included computational algorithms and numerical analysis, parallel computing, mathematical analysis of partial differential equations, statistical and stochastic methods, optimization, inversion, homogenization and renormalization. The problem areas discussed at this conference are of considerable national importance, with the increasing importance of environmental issues, global change, remediation of waste sites, declining domestic energy sources and an increasing reliance on producing the most out of established oil reservoirs.

NTIS

Conferences; Computation; Geophysics; Geochemistry; Geology; Mathematical Models; Analysis (Mathematics)

19990040818 Environmental Protection Agency, Office of Water, Washington, DC USA

Literature Review of Methods for Delineating Wellhead Protection Areas

Dec. 1998; 50p; In English

Report No.(s): PB99-129033; EPA/816/R-98/021; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This document presents an annotated bibliography of recent publications addressing technical aspects of wellhead protection area delineation. Document sections include theory, case studies, land use, geographic information systems (GIS), hydrogeologic/geologic analysis, and numerical modeling.
NTIS
Water Quality; Bibliographies; Ground Water; Literature

19990040864 Geological Survey, Water Resources Div., Pembroke, NH USA
Toxic Substance Hydrology Program: Lithology and Fracture Characterization from Drilling Investigations in the Mirror Lake Area, Grafton County, New Hampshire
Johnson, C. D.; Dunstan, A. H.; 1998; 222p; In English
Report No.(s): PB99-130015; USGS/WRI-98-4183; No Copyright; Avail: CASI; A10, Hardcopy; A03, Microfiche
The purpose of this report is to describe the hydrogeology of a bedrock aquifer and to report geologic and hydraulic information resulting from the 1979-95 drilling program at Mirror Lake. The test-drilling program included field observations recorded at the time of drilling, lithologic sampling, and detailed descriptions of rock samples. In addition, borehole-imaging techniques were used to characterize the lithology and the fractures in boreholes. This report describes the lithologic units in the study area and the well-drilling methods and other techniques used to characterize the fractures and rock-types in the boreholes.
NTIS
Aquifers; Lithology; Toxicity; Hydrogeology; Lakes; Fractures (Materials); Core Sampling

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EARTH RESOURCES AND REMOTE SENSING

Includes remote sensing of earth resources by aircraft and spacecraft; photogrammetry; and aerial photography. For instrumentation see 35 Instrumentation and Photography.

19990040547 KT-Tech, Inc., Lanham, MD USA
Research to Support Intelligent Data Management ***Final Report, Apr. 1995 - Oct. 1998***
Lerner, B. T., KT-Tech, Inc., USA; November 1998; 81p; In English
Contract(s)/Grant(s): NAS5-32893
Report No.(s): NASA/CR-1998-209226; NAs 1.26:209226; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche
This final report details the contract performance and analysis of research and development results obtained during the contract period. KT-Tech's research and development work results in the areas of registration of remotely sensed data and the test evaluation and porting of the Regional Validation Center software system are presented.
Author
Data Management; Remote Sensing; Image Processing; Image Classification; Optical Data Processing; Information Resources Management; Spectrum Analysis

19990040566 Geological Survey, Water Resources Div., Reston, VA USA
Streamflow Losses in the Black Hills of Western South Dakota
Hortness, J. E., Geological Survey, USA; Driscoll, D. G., Geological Survey, USA; 1998; 114p; In English
Report No.(s): PB99-122970; USGS/WRI-98-4116; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche
Losses occur in numerous streams that cross outcrops of various sedimentary rocks that are exposed around the periphery of the Black Hills of South Dakota. These streamflow losses are recognized as an important source of local recharge to regional bedrock aquifers. Most streams lose all of their flow up to some threshold rate. Streamflow is maintained through a loss zone when the threshold is exceeded. Streamflow records for 86 measurement sites are used to determine bedrock loss thresholds for 24 area streams, which have individual loss thresholds that range from negligible (no loss) to as much as 50 cubic feet per second. In addition, insights are provided regarding springflow that occurs in the immediate vicinity of selected loss zones.
NTIS
Bedrock; Sedimentary Rocks; Streams; Water Loss

19990040567 Geological Survey, National Water-Quality Assessment Program, Reston, VA USA
Ground-Water Quality in the Red River of the North Basin, Minnesota and North Dakota, 1991-1995
Cowdery, T. K., Geological Survey, USA; 1998; 28p; In English
Report No.(s): PB99-122962; USGS/WRI-98-4175; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The report presents the results of the Red River Basin NAWQA study-unit survey. The specific purposes of the report are: (1) to describe the water quality in surficial aquifers (in three physiographic areas) and in shallow buried aquifers; (2) to contrast and explain the water-quality differences among surficial aquifers (in each physiographic area) and between surficial and shallow buried aquifers; and (3) to describe the implications of ground-water quality on drinking water in the Red River Basin.
NTIS
Ground Water; Water Pollution; Pollution Monitoring; Aquifers; River Basins; Potable Water

19990040568 Geological Survey, Water Resources Div., Reston, VA USA
Geohydrology of Monitoring Wells Drilled in Oasis Valley Near Beatty, Nye County, Nevada, 1997
Robledo, A. R., Geological Survey, USA; Ryder, P. L., Geological Survey, USA; Fenelon, J. M., Geological Survey, USA; Paillet, F. L., Geological Survey, USA; 1998; 50p; In English
Report No.(s): PB99-122954; USGS/WRI-98-4184; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
Twelve monitoring wells were installed in 1997 at seven sites in and near Oasis Valley, Nevada. The wells, ranging in depth from 65 to 642 feet, were installed to measure water levels and to collect water-quality samples. Well-construction data and geologic and geophysical logs are presented in this report. Seven geologic units were identified and described from samples collected during the drilling.
NTIS
Hydrogeology; Water Quality; Wells; Ground Water; Geophysics; Drilling

19990040638 Forest Service, Pacific Northwest Research Station, Portland, OR USA
Proceedings: Western Juniper Forum 1997
Leavengood, S., Forest Service, USA; Swan, L., Forest Service, USA; Dec. 1998; 110p; In English
Report No.(s): PB99-123382; FSGTR-PNW-432; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche
This proceedings is a compilation of 30 articles on various aspects of the management and commercialization of western juniper. The topics are split between commercial and industrial topics, and science and management topics.
NTIS
Trees (Plants); Forest Management; Marketing; Vegetation; Forests; Commercialization

19990040700 Geological Survey, Water Resources Div., Columbus, OH USA
Factors Related to the Joint Probability of Flooding on Paired Streams ***Final Report***
Koltun, G. F., Geological Survey, USA; Sherwood, J. M., Geological Survey, USA; Jul. 1998; 48p; In English
Report No.(s): PB99-123416; USGS/WRI-98-4238; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
Factors related to the joint probability of flooding on paired streams were investigated. Stream pairs were considered to have flooded jointly at the design-year flood threshold (corresponding to the 2-, 10-, 25-, or 50-year instantaneous peak streamflow) if peak stremaflows at both streams in the pair were observed or predicted to have equalled or exceeded the threshold on a given calendar day. Daily mean streamflow data were used as a surrogate for instantaneous peak streamflow data to determine which flood thresholds were equalled or exceeded on any given day. Instantaneous peak streamflow data, when, available, were used preferentially to assess flood-threshold exceedance. Observed joint probabilities of flooding were computed as the ratios of the number of days when streamflows at both stream concurrrently equalled or exceeded their flood thresholds (events) to the number of days where streamflows at either stream equalled or exceeded its flood threshold (trials). Logistic regression equations for estimating the joint probability of flooding at the 2-year flood threshold were developed based on event-trial ratio and basin characteristic data.
NTIS
Floods; Estimating; Probability Theory; Regression Analysis; Streams

19990040755 NASA Goddard Space Flight Center, Greenbelt, MD USA
Validation of Satellite Retrieved Land Surface Variables
Lakshmi, Venkataraman, NASA Goddard Space Flight Center, USA; Susskind, Joel, NASA Goddard Space Flight Center, USA; 1999; 3p; In English; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche
The effective use of satellite observations of the land surface is limited by the lack of high spatial resolution ground data sets for validation of satellite products. Recent large scale field experiments include FIFE, HAPEX-Sahel and BOREAS which provide us with data sets that have large spatial coverage and long time coverage. It is the objective of this paper to characterize the

difference between the satellite estimates and the ground observations. This study and others along similar lines will help us in utilization of satellite retrieved data in large scale modeling studies.
Author
Data Acquisition; Satellite Observation; Earth Surface; Proving

19990040836 NASA Goddard Space Flight Center, Greenbelt, MD USA
Overview of the LANDSAT-7 Mission
Williams, Darrel, NASA Goddard Space Flight Center, USA; Irons, James, NASA Goddard Space Flight Center, USA; Goward, Samuel N., Maryland Univ., USA; Masek, Jefery, Maryland Univ., USA; [1999]; 7p; In English; Original contains color illustrations; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

LANDSAT-7 is scheduled for launch on April 15 from the Western Test Range at Vandenberg Air Force Base, Calif., on a Delta-H expendable launch vehicle. The LANDSAT 7 satellite consists of a spacecraft bus being provided by Lockheed Martin Missiles and Space (Valley Forge, Pa.) and the Enhanced Thematic Mapper Plus instrument built by Raytheon (formerly Hughes) Santa Barbara Remote Sensing (Santa Barbara, Calif.). The instrument on board LANDSAT 7 is the Enhanced Thematic Mapper Plus (ETM+). ETM+ improves upon the previous Thematic Mapper (TM) instruments on LANDSAT's 4 and 5 (Fig. la and lb). It includes the previous 7 spectral bands measuring reflected solar radiation and emitted thermal emissions but, in addition, includes a new 15 in panchromatic (visible-near infrared) band. The spatial resolution of the thermal infrared band has also been improved to 60 m. Both the radiometric precision and accuracy of the sensor are also improved from the previous TM sensors. After being launched into a sun-synchronous polar orbit, the satellite will use on-board propulsion to adjust its orbit to a circular altitude of 438 miles (705 kilometers) crossing the equator at approximately 10 a.m. on its southward track. This orbit will place LANDSAT 7 along the same ground track as previous LANDSAT satellites. The orbit will be maintained with periodic adjustments for the life of the mission. A three-axis attitude control subsystem will stabilize the satellite and keep the instrument pointed toward the Earth to within 0.05 degrees. Later this year, plans call for the NASA Earth Observation System (EOS) Terra (AM-1) observatory and the experimental EO-1 mission to closely follow LANDSAT-7's orbit to support synergistic research and applications from this new suite of terrestrial sensor systems. LANDSAT is the USA' oldest land-surface observation satellite system, with satellites continuously operating since 1972. Although the program has scored numerous successes in scientific and resource-management applications, LANDSAT has had a tumultuous history of management and funding changes over its nearly 27-year history. LANDSAT-7 marks a new direction in the program to reduce the cost of data and increase systematic global coverage for use in global change research as well as commercial and regional applications. With the passage of the Land Remote Sensing Policy Act in 1992, oversight of the LANDSAT program began to shift from the commercial sector to the federal government. NASA integrated LANDSAT-7 into its EOS science program in 1994. LANDSAT-7 is managed and operated jointly by NASA and U.S. Geological Survey (USGS). As a result, the costs of acquiring observations from
Derived from text
LANDSAT 7; Accuracy; Control Systems Design; Delta Launch Vehicle; Earth Observations (From Space); Geological Surveys; Infrared Radiation; Radiometric Resolution

19990040882 Instituto Nacional de Pesquisas Espacias, Sao Jose dos Campos, Brazil
Classification and Monitoring of Vegetation using AVHRR-NOAA ImAges ***Mapeamento e Monitoramento da Vegetacao do Estado do Mato Grosso Atraves de Imagens AVHRR-NOAA***
Yi, Jose Luis Rodriquez, Instituto Nacional de Pesquisas Espacias, Brazil; 1998; 162p; In Portuguese
Report No.(s): INPE-6816-TDI/638; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche

Vegetation, reflects in first order the complex interaction of human and the environment. Therefore from its knowledge will depend the understanding of the phenomenon in any level. The objective of this work is to present the classification and monitoring of vegetation cover, in a regional scale, using AVHRR/NOAA-11 images. The study area, Mato Grosso state, was selected due to its high diversity of vegetation cover types. The AVHRR/HRPT images acquired in the period from August 1992 to June 1994 were used in this study. Six mosaics using the maximum value NDVI composition techniques were built. For vegetation classification, the mosaic from June 1993 was selected because it was the best mosaic in that period considering the radiometric quality and cloud cover. Eight vegetation classes were mapped using supervised classification techniques using: Maxwell algorithm (for 1 and 2 AVHRR bands, and for fraction images "vegetation", "soil", and "shade") and Bhattacharrya distance "regions" algorithm for 1 and 2 segmented AVHRR bands. These classifications were evaluated using Kappa statistics based on the vegetation map of Brazil in 1: 5.000.000 scale elaborated by IBGE-IBAMA as reference ("ground truth"). The highest Kappa value (0,39) corresponded to supervised classification using "regions" algorithm from segmented bands. Other mosaics were used for the assessment of seasonal changes for the eight vegetation classes mapped. NDVI variations were in agreement with other works concerned

to the relation between NDVI and precipitation. The obtained results demonstrated the potentiality of AVHRR-NOAA images for vegetation mapping in a regional scale.
Author
Vegetation; Advanced Very High Resolution Radiometer; Annual Variations; Classifications; Ground Truth

19990040884 Instituto Nacional de Pesquisas Espacias, Sao Jose dos Campos, Brazil
Digital Mosaic of LANDSAT-TM Images From the Solimoes-Amazon River Floodplain in Brazil ***Mosaico Digital de Imagens LANDSAT-TM da Planicie do Rio Solimoes-Amazonas no Brasil***
Shimabukuro, Yosio Edmir, Instituto Nacional de Pesquisas Espacias, Brazil; deMoraesNovo, Evlyn Marcia Leao, Instituto Nacional de Pesquisas Espacias, Brazil; Mertes, Leal A. K., California Univ., USA; 1998; 67p; In Portuguese
Report No.(s): INPE-6746-RPQ/681; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

This report describes the methodology utilized to build the Digital Mosaic of the Amazon River Floodplain (MDPA) using LANDSAT TM images. This mosaic was planned in July 1995 as na activity of the EOS-IDS Project that has been developed inside the cooperation among INPE, CENA, University of Washington in Seattle (UW), University of California in Santa Barbara (UCSB), and NASA. The MDPA is composed by 29 LANDSAT TM images that were selected with minimum cloud cover and within the high water season of Amazon river. These images were geometrically corrected using ground control points extracted from topographic charts and image charts in the 1:250,000 scale. In addition, these images were radiometrically rectified to 231/062 (Manaus region) TM image using the method developed by Hall et al. (1991). The radiometric rectification produce different results for TM bands due to atmospheric effects and scene characteristics. The MDPA was then built using the best bands (rectified or non-rectified) of the TM images with a 100 m by 100 m spatial resolution.
Author
Amazon Region (South America); Procedures; Flood Plains; Topography; Spatial Resolution; Mosaics

19990040927 NASA Goddard Space Flight Center, Greenbelt, MD USA
Surface Temperature Assimilation in Land Surface Models
Lakshmi, Venkataraman, NASA Goddard Space Flight Center, USA; [1997]; 3p; In English; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

This paper examines the utilization of surface temperature as a variable to be assimilated in offline land surface hydrological models. Comparisons between the model computed and satellite observed surface temperatures have been carried out. The assimilation of surface temperature is carried out twice a day (corresponding to the AM and PM overpass of the NOAA10) over the Red-Arkansas basin in the Southwestern USA (31 deg 50 min N - 36 deg N, 94 deg 30 min W - 104 deg 30 min W) for a period of one year (August 1987 to July 1988). The effect of assimilation is to reduce the difference between the surface soil moisture computed for the precipitation and/or shortwave radiation perturbed case and the unperturbed case compared to no assimilation.
Author
Surface Temperature; Assimilation; Hydrology Models; Research

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ENERGY PRODUCTION AND CONVERSION

Includes specific energy conversion systems, e.g., fuel cells; global sources of energy; geophysical conversion; and windpower. For related information see also 07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power, and 28 Propellants and Fuels.

19990039119 NASA Goddard Space Flight Center, Greenbelt, MD USA
A Flight Prediction for Performance of the SWAS Solar Array Deployment Mechanism
Seniderman, Gary, NASA Goddard Space Flight Center, USA; Daniel, Walter K., Mechanical Dynamics, Inc., USA; 1999; 15p; In English; 33rd; Aerospace Mechanism, 11-14 May 1999, Pasadena, CA, USA; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The focus of this paper is a comparison of ground-based solar array deployment tests with the on-orbit deployment. The discussion includes a summary of the mechanisms involved and the correlation of a dynamics model with ground based test results. Some of the unique characteristics of the mechanisms are explained through the analysis of force and angle data acquired from the test deployments. The correlated dynamics model is then used to predict the performance of the system in its flight application.
Author
Performance Tests; Solar Arrays; Ground Tests

19990039125 Department of Energy, Assistant Secretary for Energy Efficiency and Renewable Energy, Washington, DC USA
Development of a 250-kW modular, factory-assembled battery energy storage system ***Final Report***
Porter, D., Department of Energy, USA; Nerbun, W., Department of Energy, USA; Corey, G., Department of Energy, USA; Aug. 31, 1998; 250p; In English
Report No.(s): DE98-006186; SAND-97-1276; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

A power management energy storage system was developed for stationary applications such as peak shaving, voltage regulation, and spinning reserve. Project activities included design, manufacture, factory testing, and field installation. The major features that characterize the development are the modularity of the production, its transportability, the power conversion method that aggregates power on the AC side of the converter, and the use of commonly employed technology for system components. NTIS

Energy Storage; Electric Batteries

19990039127 Department of Energy, Assistant Secretary for Energy Efficiency and Renewable Energy, Washington, DC USA
Energy storage systems program report for FY97
Butler, P. C., Department of Energy, USA; Aug. 31, 1998; 104p; In English
Report No.(s): DE98-006272; SAND-98-1733; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Sandia National Laboratories, New Mexico, conducts the Energy Storage Systems Program, which is sponsored by the US Department of Energy's Office of Utility Technologies. The goal of this program is to collaborate with industry in developing cost-effective electric energy storage systems for many high-value stationary applications. Sandia National Laboratories is responsible for the engineering analyses, contracted development, and testing of energy storage components and systems. This report details the technical achievements realized during fiscal year 1997. NTIS

Electric Energy Storage; Research and Development; Project Management

19990039130 Department of Energy, Assistant Secretary for Energy Efficiency and Renewable Energy, Washington, DC USA
Environmental assessment of advanced thin film manufacturing process ***Final Report***
Cunningham, D. W., Department of Energy, USA; Mopas, E., Department of Energy, USA; Skinner, D., Department of Energy, USA; McGuire, L., Department of Energy, USA; Strehlow, M., Department of Energy, USA; Sep. 30, 1998; 42p; In English
Report No.(s): DE98-006468; NREL/SR-520-25111; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

This report describes work performed by BP Solar, Inc., to provide an extensive preproduction analysis of waste-stream abatement at its plant in Fairfield, California. During the study, numerous technologies were thoroughly evaluated, which allowed BP Solar to select systems that outperformed the stringent federal and state regulations. The main issues were originally perceived to be controlling cadmium compound releases to both air and wastewater to acceptable levels and adopting technologies for air and water waste streams in an efficient, cost-effective manner. BP Solar proposed high- efficiency, reliable control equipment that would reduce air-contaminant emission levels below levels of concern. Cadmium telluride dust is successfully controlled with high-efficiency (greater than 99.9%) bag-in/bag-out filters. For air abatement, carbon canisters provide efficient VOC reduction, and wastewater pretreatment is required per federal pretreatment standards. BP Solar installed a cadmium-scavenging ion exchange system and electrowinning system capable of removing cadmium to less than 10 ppb (local publicly-owned-treatment-works limits for cadmium is 30 ppb). BP Solar plans to maximize potential reuse of rinse waters by phasing in additional wastewater treatment technologies. Finally, the work to date has identified the areas that need to be revisited as production scales up to ensure that all health, safety, and environmental goals are met. NTIS

Waste Management; Cadmium Tellurides; Pollution Control; Control Equipment; Contaminants; Waste Water; Thin Films; Manufacturing; Electrowinning

19990039131 Department of Energy, Assistant Secretary for Energy Efficiency and Renewable Energy, Washington, DC USA
High-throughput manufacturing of thin-film CdS/CdTe photovoltaic modules ***Annual Report, 16 Sep. 1996 - 15 Jan. 1998***
Sandwisch, D. W., Department of Energy, USA; Aug. 31, 1998; 43p; In English
Report No.(s): DE98-006469; NREL/SR-520-25263; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Cadmium telluride (CdTe) is recognized as one of the leading materials for low-cost photovoltaic modules. Solar Cells, Inc., has developed this technology and is scaling its pilot production capabilities to a multi-megawatt level. The Photovoltaic Manufacturing Technology (PVMaT) subcontract supports these efforts. Activities during the third phase of the program concen-

trated on process development, equipment design and testing, quality assurance, ES and H programs, and large-scale next-generation coating-system prototype development. These efforts broadly addressed the issues of the manufacturing process for producing thin-film, monolithic CdS/CdTe photovoltaic modules.
NTIS
Cadmium Tellurides; Photovoltaic Cells; Manufacturing; Cadmium Sulfides; Thin Films; Vapor Deposition

19990039137 Department of Energy, Assistant Secretary for Energy Efficiency and Renewable Energy, Washington, DC USA
Axial flux, modular, permanent-magnet generator with a toroidal winding for wind turbine applications
Muljadi, E., Department of Energy, USA; Butterfield, C. P., Department of Energy, USA; Wan, Y. H., Department of Energy, USA; Jul. 31, 1998; 6p; In English; Sponsored by Institute of Electrical and Electronics Engineers, USA
Report No.(s): DE98-007235; NREL/CP-500-24996; CONF-981114; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Permanent-magnet generators have been used for wind turbines for many years. Many small wind turbine manufacturers use direct-drive permanent-magnet generators. For wind turbine generators, the design philosophy must cover the following characteristics: low cost, light weight, low speed, high torque, and variable speed generation. The generator is easy to manufacture and the design can be scaled up for a larger size without major retooling. A modular permanent-magnet generator with axial flux direction was chosen. The permanent magnet used is NdFeB or ferrite magnet with flux guide to focus flux density in the air gap. Each unit module of the generator may consist of one, two, or more phases. Each generator can be expanded to two or more unit modules. Each unit module is built from simple modular poles. The stator winding is formed like a torus. Thus, the assembly process is simplified and the winding insertion in the slot is less tedious. The authors built a prototype of one unit module and performed preliminary tests in the laboratory. Follow up tests will be conducted in the lab to improve the design.
NTIS
Electric Generators; Wind Turbines; Permanent Magnets; Design Analysis; Mechanical Drives

19990039577 Department of Energy, Assistant Secretary for Management and Administration, Washington, DC USA
Molecular modeling of the pendant chain in Nafion(reg-sign)
Paddison, S. J., Department of Energy, USA; Zawodzinski, T. A., Department of Energy, USA; Mar. 31, 1998; 23p; In English; Solid State Ionics, 1997, USA
Report No.(s): DE98-002941; LA-UR-97-4414; CONF-971196; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Ion transport through perfluorosulfonic acid ionomers such as Nafion(reg-sign) is controlled by both the microstructure of the polymer and the charge and water distribution in the hydrated polymer. The authors present here the results of theoretical calculations on the side chain of Nafion(reg-sign), establishing microscopic information for the modeling of water modeling of water modeling of water and proton transport in the membrane. Optimized geometries for the trifluoromethane sulfonic acid fragment (CF3)) SO3H, the di-trifluoromethane ether fragment CF3OCF3, and the side chain (CF3(single-bond)OCF2CF(CF3)OCF2CF2 SO3H were determined by means of both ab initio Hartree Fock theory with second order Moeller-Plesset electron correlation corrections, and density functional theory with Becke's three parameter hybrid method. Several rotational potential energy surfaces were calculated to assess chain flexibility and proton accessibility. A probe water molecule was added to each of the fragments to characterize hydrophilic sites. These calculations confirmed that the sulfonic acid group is hydrophilic and the ethers are hydrophobic. Molecular dynamics simulations were then performed on the side chain to check the conditions required to stretch the pendant chain. Thermal averages of several structural parameters assessing the flexibility and stretch of the chain were computed from selected conformations produced in the simulation and these results indicate that although the sulfonate group is free to rotate, the chain stretches little. The construction of a potential energy surface for rotation about the second ether group suggests that the side chain exists in a folded or curled up conformation. A physical continuum dielectric solvent model was used to obtain free energies of electrostatic interaction of the fragments and the full chain with the solvent.
NTIS
Molecular Dynamics; Nuclear Models; Ion Currents; Fluorine Organic Compounds; Continuum Modeling

19990039589 Department of Energy, Washington, DC USA
Novel carbonaceous materials used as anodes in lithium ion cells
Sandi, G., Department of Energy, USA; Winans, R. E., Department of Energy, USA; Carrado, K. A., Department of Energy, USA; Sep. 30, 1997; 4p; In English; Advanced Non-Aqueous Battery Research and Development, USA
Report No.(s): DE98-000295; ANL/CHM/CP-94486; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The objective of this work is to synthesize disordered carbons used as anodes in lithium ion batteries, where the porosity and surface area are controlled. Both parameters are critical since the irreversible capacity obtained in the first cycle seems to be associated with the surface area (an exfoliation mechanism occurs in which the exposed surface area continues to increase).
NTIS
Carbonaceous Materials; Lithium; Cell Anodes; Metal Ions

19990039593 Department of Energy, Washington, DC USA
Rare earth thermoelectrics
Mahan, G. D., Department of Energy, USA; Sep. 30, 1997; 10p; In English; 16th; Thermoelectrics (ICT-10), USA
Report No.(s): DE98-000337; ORNL/CP-94414; CONF-970838; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The author reviews the thermoelectric properties of metallic compounds which contain rare-earth atoms. They are the group of metals with the largest value ever reported of the Seebeck coefficient. An increase by 50% of the Seebeck would make these compounds useful for thermoelectric devices. The largest Seebeck coefficient is found for compounds of cerium (e.g., CePd3) and ytterbium (e.g., YbAl3). Theoretical predictions are in agreement with the maximum observed Seebeck. The author discusses the theoretical model which has been used to calculate the Seebeck coefficient. He is solving this model for other configurations (4f)(sup n) of rare-earth ground states.
NTIS
Thermoelectricity; Rare Earth Elements; Metals

19990040233 Department of Energy, Assistant Secretary for Energy Efficiency and Renewable Energy, Washington, DC USA
Development of flame retardant PV module encapsulants, Volume 1 ***Final Report***
Galica, J. P., Department of Energy, USA; Jun. 30, 1998; 62p; In English
Report No.(s): DE99-000122; DOE/GO/10255-T1-VOL.1; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

This Phase 1 final report covers the work performed by Springborn Testing and Research, Inc., for the period October 1, 1997 to June 30, 1998 under the Department of Energy Cooperative Agreement Number DE-FC36-97GO10255, entitled Development of Flame Retardant PV Module Encapsulants. While use of roof-mounted arrays has always been an attractive means of deploying PV, only within recent years have such building integrated concepts (BIPV) found renewed interest among module makers and end-users. Prior to building integrated and rooftop applications, flammability requirements for modules have not been a great industry concern. However, with growing interest in BIPV and the requirement for building code requirements for commercial and industrial structures, flammability issues have become a barrier to entry for many module constructions into this potentially huge domestic market for PV. The overall goal of the 3 phase PV BONUS two project is to develop and commercialize a line of fire retardant encapsulation materials to serve the emerging building integrated and building mounted PV market. The objectives of the Phase 1 effort are limited to concept development and business planning activities.
NTIS
Construction Materials; Flammability; Encapsulating; Flame Retardants; Solar Cells

19990040234 Department of Energy, Assistant Secretary for Energy Efficiency and Renewable Energy, Washington, DC USA
SolarTile: A rooftop integrated photovoltaic system ***Final Report***
Mar. 26, 1998; 14p; In English
Report No.(s): DE99-000133; DOE/GO/10246-T1; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

AstroPower, Royal Group Technologies, and Solar Design Associates are jointly developing an integrated photovoltaic roofing system for residential and light commercial building applications. This family of products will rely heavily on the technological development of a roofing tile made from recycled plastic and innovative module fabrication and encapsulation processes in conjunction with an advanced Silicon-Film(trademark) solar cell product. This solar power generating roofing product is presently being referred to as the SolarTile. A conceptual drawing of the solar roofing tile is shown. The SolarTile will be integrated with non-solar tiles in a single roof installation permitting ease of assembly and the ability to use conventional roofing techniques at ridges, valleys, and eaves. The Phase 1 effort included tasks aimed at the development of the proposed product concept; product manufacturing or fabrication, and installation cost estimates; business planning; and a market assessment of the proposed product, including target selling prices, target market sectors, size estimates for each market sector, and planned distribution mechanisms for market penetration. Technical goals as stated in the Phase 1 proposal and relevant progress are reported.
NTIS
Photovoltaic Conversion; Encapsulating; Solar Cells; Roofs; Manufacturing

19990040580 Department of Energy, Assistant Secretary for Energy Efficiency and Renewable Energy, Washington, DC USA
Fuel cells for transportation R and D at Argonne National Laboratory
Kumar, R., Department of Energy, USA; Ahmed, S., Department of Energy, USA; Bloom, I., Department of Energy, USA; Carter, J. D., Department of Energy, USA; Doshi, R., Department of Energy, USA; Oct. 31, 1997; 20p; In English; Automotive Technology Development Customers' Coordination, USA
Report No.(s): DE98-050039; ANL/CMT/CP-94665; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

This paper describes the transportation fuel cell systems research at Argonne National Laboratory (ANL). Two areas of research are discussed: the development of a catalytic partial-oxidation reformer for conventional and alternative transportation fuels, and a novel approach for the removal of carbon monoxide from reformate for use in polymer electrolyte fuel cells. The objective of the first study is to develop reformers for converting liquid fuels (gasoline, ethanol, or methanol) to hydrogen gas for use with fuel cell systems in light-duty vehicles. The second study is investigating the use of acidic cuprous chloride (or other suitable sorbent) to chemically bind and thus remove the CO from the reformate.
NTIS
Fuel Cells; Transportation; Electrolytic Cells

19990040797 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA USA
Thermoelectric materials development ***Final Report***
Fleurial, J. P.; Caillat, T.; Borshchevsky, A.; Sep. 30, 1998; 200p; In English
Report No.(s): DE99-001096; DOE/SF/17905-T11; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

A systematic search for advanced thermoelectric materials was initiated at JPL several years ago to evaluate candidate materials which includes consideration of the following property attributes: (1) semiconducting properties; (2) large Seebeck coefficient; (3) high carrier mobility and high electrical conductivity; (4) low lattice thermal conductivity; and (5) chemical stability and low vapor pressure. Through this candidate screening process, JPL identified several families of materials as promising candidates for improved thermoelectric materials including the skutterudite family. As part of an ongoing effort to develop skutterudite materials with lower thermal conductivity values, several solid solutions and filled skutterudite materials were investigated under the effort sponsored by DOE. The efforts have primarily focused on: (1) study of existence and properties of solid solutions between the binary compounds CoSb3 and IrSb3, and RuSb2Te, and (2) CeFe(4-x)Sb12 based filled compositions. For the solid solutions, the lattice thermal conductivity reduction was expected to be reduced by the introduction of the Te and Ru atoms while in the case of CeFe(4-x)Ru(x)Sb12 based filled compositions. For the solid solutions, the lattice thermal conductivity reduction was expected to be reduced by the introduction of the Te and Ru atoms while in the case of CeFe(4-x)Ru(x)Sb12 filled compositions, the reduction would be caused by the rattling of Ce atoms located in the empty voids of the skutterudite structure and the substitution of Fe for Ru. The details of the sample preparation and characterization of their thermoelectric properties are reported in this report.
NTIS
Thermoelectric Materials; Product Development; Semiconductors (Materials); Electrical Resistivity

19990040811 Department of Energy, Assistant Secretary for Fossil Energy, Washington, DC USA
Molten carbonate fuel cell product development test ***Final Report, 30 Sep. 1992 - 31 Mar. 1997***
Dec. 31, 1997; 93p; In English
Report No.(s): DE98-058028; DOE/MC/28065-1; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

This report summarizes the work performed for manufacturing and demonstrating the performance of its 250-kW molten carbonate fuel cell (MCFC) stack in an integrated system at the Naval Air Station Miramar (NAS Miramar) located in San Diego, California. The stack constructed for the demonstration test at the NAS Miramar consisted of 250 cells. It was manufactured using M-C Power's patented Internally Manifolded Heat Exchanger (IMHEX(reg-sign)) stack design. The demonstration test at NAS Miramar was designed to operate the 250-kW MCFC stack in a cogeneration mode. This test represented the first attempt to thermally integrate an MCFC stack in a cogeneration system. The test produced 160 MWh of d.c. power and 346,000 lbs of 110 psig steam for export during 1,566 hours of on-load operations. The test demonstrated a d.c. power output of 206 kW. Most of the balance of the plant (BOP) equipment operated satisfactorily. However, the off-the-shelf automotive turbocharger used for supplying air to the plant failed on numerous occasions and the hot gas blower developed seal leakage problems which impacted continuous plant operations. Overall the demonstration test at NAS Miramar was successful in demonstrating many critical features of the IMHEX technology.
NTIS
Product Development; Performance Tests; Heat Exchangers; High Temperature Gases; Molten Carbonate Fuel Cells; Superchargers

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ENVIRONMENT POLLUTION

Includes atmospheric, noise, thermal, and water pollution.

19990036573 State Committee on Hydrometeorology and Control of the Natural Environment, Moscow, USSR
Climate Change Impact Studies: The IPCC Working Group 2 Report
Izrael, Yu. A., State Committee on Hydrometeorology and Control of the Natural Environment, USSR; Climate Change: Science, Impacts and Policy; 1991, pp. 83-86; In English; See also 19990036567; Copyright; Avail: Issuing Activity (World Meteorology Organization, Geneva, Switzerland), Hardcopy, Microfiche

This paper describes the second IPCC working group's climate change impact assessments. The paper assess the potential impact of global climate change on (1) agriculture, (2) natural terrestrial ecosystems, (3) hydrology and water resources (4) human settlements, (5) the world oceans, and (6) seasonal snow cover, ice and permafrost.
CASI
Climate Change; Damage Assessment; Impact; Global Warming

19990038344 Geological Survey, Biological Resources Div., Laurel, MD USA
Nickel Hazards to Fish, Wildlife, and Invertebrates: A Synoptic Review
Eisler, Ronald, Geological Survey, USA; Apr. 1998; 86p; In English
Report No.(s): AD-A361155; USGS/BRD/BSR--1998-0001; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

This account is a selective review and synthesis of the technical literature on nickel and nickel salts in the environment and their effects on terrestrial plants and invertebrates, aquatic plants and animals, avian and mammalian wildlife, and other natural resources. The subtopics include nickel sources and uses; physical, chemical, and metabolic properties of nickel; nickel concentrations in field collections of abiotic materials and living organisms; nickel deficiency effects; lethal and sublethal effects, including effects on survival, growth, reproduction, metabolism, mutagenicity, teratogenicity, and carcinogenicity; currently proposed nickel criteria for the protection of human health and sensitive natural resources; and recommendations for additional research.
DTIC
Nickel; Fishes; Wildlife; Invertebrates; Toxic Hazards

19990039092 Air Force Inst. of Tech., School of Engineering, Wright-Patterson AFB, OH USA
Survey of Military Applications for Fourier Transform Infrared (FTIR) Spectroscopy
Hauser, Robert G.; Feb. 1999; 146p; In English
Report No.(s): AD-A361424; AFIT/GM/ENP/99M-07; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

This paper surveyed four potential military uses for a Fourier Transform Infrared (FTIR) Spectrometer. A physical method to retrieve vertical atmospheric temperature profiles using a least-squares solution on atmospheric radiance observed at the surface in the 4.3-micrometer carbon dioxide absorption band was analyzed. The method was not successful. Weighting functions, calculated from the surface looking up, were a maximum at the surface, so no unique solution for temperature retrieval by height was determined. Observed atmospheric radiance measurements were compared with radiance calculated using the Moderate Resolution Transmittance Code (MODTRAN). Qualitative comparison showed spectral features of observed and calculated radiance plots matched exceptionally well. The utility of the FTIR spectrometer for environmental monitoring was demonstrated by identifying CO2, CO, O3, HCl, SO2, and N2O emissions from a coal-burning plant smokestack. An FTIR spectrometer was used to collect data of controlled detonations of statically displayed Mk 82, Mk 83, and Mk 84 bombs; High-speed Anti-Radiant Missiles (HARM); Tomahawk Land-Attack Missiles (TLAM); and C-4 plastic explosive over the 1800-6000 /cm spectral band at 16 /cm resolution. Results showed there were unique spectral features associated with some warhead types.
DTIC
Explosions; Fourier Transformation; Infrared Spectrometers; Carbon Dioxide; Environmental Monitoring; Nitrogen Oxides

19990039120 Royal Netherlands Meteorological Inst., Klimatologische Dienstverlening, De Bilt, Netherlands
Indices that Describe Climate Changes and Extremes ***Indices die de Variabiliteit en de Extremen van het Klimaat Beschrijven***
Klok, E. J., Royal Netherlands Meteorological Inst., Netherlands; September 1998; ISSN 0169-1708; In Danish
Report No.(s): KNMI-TR-211; ISBN 90-369-2148-1; Copyright; Avail: Issuing Activity (KNMI, P.O. Box 201, 3730 AE De Bilt, Wilhelminalaan 10, The Netherlands), Hardcopy, Microfiche

In 1995 the European Climate Support Network (ECSN) issued a report called "Climate of Europe, Recent Change, Current State, and Future Forecasts." This report is the first of a series called "European Climate Assessments," which are directed at scien-

tific and climate organizations, but which also have the purpose of informing the general public about climate changes. The ”Second European Climate Assessment” will appear in the year 2000. The KNMI will provide an important contribution to the realization of this report. Its content will focus on European climate changes and extremes and the variability of phenomena influencing climate. Among other things, these are characteristic air patterns such as the ”North Atlantic Oscillation” (NAO) and the ”East Atlantic Pattern.” Whether or not El Nino is influencing the European climate is not clear. Moreover, the predictability of this phenomenon will be examined. Extremes in climate has been a hot topic for many years, and much has been written on it. Also, the ”Third Assessment Report” of the ”Intergovernmental Panel on Climate Change” (IPCC), which will be published at the end of this century, will discuss whether climate has become more extreme or has fluctuated more. CLIVAR is a program that the IPCC has supported. For this reason, in cooperation with the GCOS (Global Climate Observing System) and the WMO (World Meteorological Organization), in 1997 CLIVAR organized a workshop on indices and indicators for climate extremes. The ECSN also provided a contribution to the IPCC report called ”European Climate Assessment.”
Derived from text
Climate Change; El Nino; Climatology; Forecasting; Predictions

19990039140 Department of Energy, Office of Energy Research, Washington, DC USA
SAGE II/Umkehr ozone comparisons and aerosols effects: An empirical and theoretical study ***Final Report***
Newchurch, M., Department of Energy, USA; Sep. 15, 1997; 4p; In English
Report No.(s): DE99-000954; DOE/ER/61730-T2; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
The objectives of this research were to: (1) examine empirically the aerosol effect on Umkehr ozone profiles using SAGE II aerosol and ozone data; (2) examine theoretically the aerosol effect on Umkehr ozone profiles; (3) examine the differences between SAGE II ozone profiles and both old- and new- format Umkehr ozone profiles for ozone-trend information; (4) reexamine SAGE I- Umkehr ozone differences with the most recent version of SAGE I data; and (5) contribute to the SAGE II science team.
NTIS
Ozone; Aerosols; Umkehr Effect

19990039174 NASA Ames Research Center, Moffett Field, CA USA
Stratospheric Cooling and Arctic Ozone Recovery
Danilin, Michael Y., Atmospheric and Environmental Research, Inc., USA; Sze, Nien-Dak, Atmospheric and Environmental Research, Inc., USA; Ko, Malcolm K. W., Atmospheric and Environmental Research, Inc., USA; Rodriquez, Jose M., Atmospheric and Environmental Research, Inc., USA; Geophysical Research Letters; Jun. 15, 1998; ISSN 0094-8534; Volume 25, No. 12, pp. 2141-2144; In English
Contract(s)/Grant(s): NAS5-97039; NAS5-32844
Report No.(s): Paper-98GL01587; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche
We present sensitivity studies using the AER box model for an idealized parcel in the lower stratosphere at 70 deg N during winter/spring with different assumed stratospheric cooling and chlorine loadings. Our calculations show that stratospheric cooling could further deplete ozone via increased polar stratospheric cloud (PSC) formation and retard its expected recovery even with the projected chlorine loading decrease. We introduce the concept of chlorine-cooling equivalent and show that a 1 K Cooling could provide the same local ozone depletion as an increase of chlorine by 0.4-0.7 ppbv for the scenarios considered. Thus, sustained stratospheric cooling could further reduce Arctic ozone content and delay the anticipated ozone recovery in the Northern Hemisphere even with the realization of the Montreal Protocol and its Amendments.
Author
Cooling; Stratosphere; Arctic Regions; Ozone Depletion; Research; Computation; Polar Meteorology; Air Law

19990039199 Department of Energy, Washington, DC USA
Thyratron-based pulse generator for fundamental studies of NO(x) removal in nonthermal plasmas
Korzekwa, R. A., Department of Defense, USA; Rosocha, L. A., Department of Defense, USA; Sep. 30, 1997; 10p; In English; Diesel Engine Emissions Reduction, 1997, USA
Report No.(s): DE98-000252; LA-UR-97-3468; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
The authors are investigating the removal of NO(x) from engine exhaust streams using nonthermal plasmas (NTPs). The near-term experiments focus on measuring temperature distributions and reactive species concentrations in electric discharge NTP reactors using laser induced fluorescence (LIF) and tunable diode laser absorption spectroscopy (TDLAS), with first experiments on LIF measurements of OH in a pulsed dielectric-barrier discharge. Because the self extinguishing microdischarges in a conventional (low frequency

driven) barrier discharge are both short lived (a few to a few tens of nanoseconds) and randomly distributed in the process volume, it is difficult to measure the time-varying properties of the species produced by the plasma. to synchronize the plasma ignition with the optical diagnostics, a thyratron switched, high voltage pulse generator has been constructed to drive a small dielectric- barrier plasma cell. A fast rise time thyratron tube is used in a low inductance geometry to deliver a negative high voltage pulse to the cell. The output voltage pulse has a rise time of 6.5 ns, a peak voltage of 40 kV, and a repetition rate of 20 Hz. A microdischarge streamer occurs between the pin electrode and the glass barrier during the rise time of the voltage pulse. The delay between the input signal and the microdischarge is 250 ns with a jitter of 4 ns, thus allowing repetitive initiation of a microdischarge with low temporal jitter. The energy per pulse is obtained from the voltage and current versus time, v(t) and i(t), measured at the cell. The fast rising pulse also produces a higher E/N at breakdown in the discharge than in conventional NTP cells, which may affect the removal efficiency of pollutants.
NTIS
Pollution Control; Nitrogen Oxides; Pulse Generators; Research; Exhaust Nozzles; Removal; Contaminants; Air Pollution

19990039566 Oregon Graduate Inst. of Science and Technology, Beaverton, OR USA
Natural Attenuation of MTBE in an Anaerobic Groundwater Plume: Advanced Fuel Hydrocarbon Remediation National Test Location
Heath, Jeff; Lory, Ernie; Feb. 1999; 6p; In English; Prepared in cooperation with Arizona State University, Tempe, AZ.
Report No.(s): AD-A361251; TDS-2068-ENV; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Methyl tertiary butyl ether (MTBE) is a compound commonly added to petroleum fuels as an oxygenate or octane enhancer often at concentrations above 10% by volume. MTBE is currently in 70% of the gasoline used in the U.S. Due to its high water solubility, it is commonly a significant groundwater contaminant at sites affected by fuel spills. Once in the groundwater, MTBE migrates due to predominate water flow with little retardation, but may be removed by volatilization or degradation under the right conditions. A natural attenuation study is being conducted at Port Hueneme, California, to gather information on the behavior and degradation of MTBE under conditions common to fuel contaminated sites, under oxygen depleted conditions, resulting from microbial degradation of other petroleum hydrocarbons. The study site is an existing fuel hydrocarbon plume that resulted from 1984 fuel release at the Navy Exchange service station at Port Hueneme, California. The plume occurs in a shallow semi-perched water table aquifer. Constituents of concern are the compounds, benzene, toluene, ethyl benzene, and xylene (the BTEX compounds) and MTBE. A numerical model of the groundwater flow at the study site will be developed to better understand the relative importance of advection/dispersion and degradation to the migration of MTBE. Tracer tests will yield quantitative information on the fate of MTBE during migration under reducing conditions in the presence of other fuel hydrocarbons. Numerical model data will provide a means to transfer information learned at this site to other DOD and Na sites where MTBE contamination is present.
DTIC
Fuels; Ground Water; Hydrocarbons; Plumes; Petroleum Products

19990039568 Royal Netherlands Meteorological Inst., De Bilt, Netherlands
Operational UV-Measurements at the KNMI (Royal Dutch Meteorological Institute) ***Operationele UV-Metingen bi het KNMI***
Kulk, F., Royal Netherlands Meteorological Inst., Netherlands; November 1997; ISSN 0169-1708; In Dutch
Report No.(s): KNMI-TR-200; ISBN 90-369-2127-9; Copyright; Avail: Issuing Activity (KNMI, PO Box 201, 3730 AE De Bilt, Wilhelminalaan 10, De Bilt, The Netherlands), Hardcopy, Microfiche

Ultraviolet radiation (UV) is a significant radiation risk in sufficient quantity. to name some examples, UV can cause skin cancer in people; it can influence the growth of animals and plant life; it affects all types of materials, etc. to which degree this happens depends upon the amount of UV that is found on the earth's surface and in our environment. Where UV is present in significant quantities, more societal importance is being given and its trends are being monitored. It is known that the thickness of the ozone layer in the Northern Hemisphere has also thinned in the past decades. Since ozone absorbs UV, it may be concluded that the amount of UV in our environment will increase, along with all its troublesome consequences. However, the atmosphere is a very dynamic system. Not counting a decrease in the amount of ozone, there are many ongoing climatic processes that by way of reaction can reduce the amount of UV (for example an increase in the amount of clouds or aerosol).
Derived from text
Ultraviolet Radiation; Ozone; Climatology; Ozonosphere; Risk

19990039587 Department of Energy, Office of Energy Research, Washington, DC USA
Elevated CO2 in a prototype free-air CO2 enrichment facility affects photosynthetic nitrogen relations in a maturing pine forest
Ellsworth, D. S., Department of Energy, USA; LaRoche, J., Department of Energy, USA; Hendrey, G. R., Department of Energy,

USA; Mar. 31, 1998; 49p; In English
Report No.(s): DE98-005741; BNL-52545; No Copyright; Avail: Issuing Activity, Microfiche

A maturing loblolly pine (Pinus taeda L.) forest was exposed to elevated CO2 in the natural environment in a perturbation study conducted over three seasons using the free-air CO2 enrichment (FACE) technique. At the time measurements were begun in this study, the pine canopy was comprised entirely of foliage which had developed under elevated CO2 conditions (atmospheric CO2 (approx) 550 (micro)mol/mol(sup (minus)1)). Measurements of leaf photosynthetic responses to CO2 were taken to examine the effects of elevated CO2 on photosynthetic N nutrition in a pine canopy under elevated CO(sub 2). Photosynthetic CO2 response curves (A-c(sub i) curves) were similar in FACE trees under elevated CO2 compared with counterpart trees in ambient plots for the first foliage cohort produced in the second season of CO2 exposure, with changes in curve form detected in the foliage cohorts subsequently produced under elevated CO2. Differences in the functional relationship between carboxylation rate and N(sub a) suggest that for a given N(sub a) allocated among successive cohorts of foliage in the upper canopy, V(sub c max) was 17% lower in FACE versus Ambient trees. The authors also found that foliar Rubisco content per unit total protein derived from Western blot analysis was lower in late-season foliage in FACE foliage compared with ambient-grown foliage. The results illustrate a potentially important mode of physiological adjustment to growth conditions that may operate in forest canopies. Findings suggest that mature loblolly pine trees growing in the field may have the capacity for shifts in intrinsic nitrogen utilization for photosynthesis under elevated CO2 that are not dependent on changes in leaf N. Findings suggest a need for continued examination of internal feedbacks at the whole-tree and ecosystem level in forests that may influence long-term photosynthetic responses to elevated CO2.

NTIS

Carbon Dioxide; Nitrogen; Atmospheric Composition; Carbon Dioxide Concentration; Canopies (Vegetation); Conifers; Ecosystems

19990039605 Department of Energy, Washington, DC USA

Three-dimensional model for simulating atmospheric dispersion of heavy-gases over complex terrain

Chan, S. T., Department of Energy, USA; Sep. 01, 1997; 8p; In English
Report No.(s): DE98-053184; UCRL-JC-127475; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

To help understand heavy gas releases and simulate the resultant dispersion, we have developed a three-dimensional finite element model called FEM3 and an improved version names FEM3A for solving the time dependent conservation equations based on generalized anelastic approximation. Recent enhancements to the model to include the treatment of dispersion scenarios involving density variations much larger than the liquefied natural gas range and an advanced turbulence submodel based on the buoyancy-extended transport equations. This paper presents the main features of the present model FEM3C and numerical results from the simulations of a field-scale LNG spill experiment.

NTIS

Three Dimensional Models; Atmospheric Composition; Atmospheric Models; Liquefied Natural Gas; Terrain; Dispersions

19990039606 Department of Energy, Washington, DC USA

Nocturnal wind direction shear and its potential impact on pollutant transport

Bowen, B. M., Department of Energy, USA; Baars, J. A., Department of Energy, USA; Stone, G. L., Department of Energy, USA; Sep. 01, 1997; 9p; In English; 9th; Global Change Studies, USA; Sponsored by American Meteorological Society, USA
Report No.(s): DE98-053713; UCRL-JC-127328; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The estimation of transport and diffusion of airborne pollutants during the nighttime is challenging, especially over complex terrain where gravity driven drainage flows may be overlain with wind from a different direction. This study investigates the character of wind direction shear in the lowest 100 m using tower measurements from a complex, semi-arid site where local thermally-driven flows are common. The effects of wind direction shear on plume transport are studied by simulating a hypothetical elevated term release. This is accomplished by first simulating transport and dispersion using wind measurements from only the 12 m level from a network of towers. This case represents the approach commonly taken at many facilities where a network of short towers is available. Then the release is modeled using wind measurements made at four levels in the lowest 100 m. The differences between the two simulations are significant and would lead to very different responses in an emergency situation.

NTIS

Nocturnal Variations; Wind Direction; Pollution Transport; Wind Effects

19990039655 NASA Langley Research Center, Hampton, VA USA

Nitrogen Species in the Post-Pinatubo Stratosphere: Model Analysis Utilizing UARS Measurements

Danilin, M. Y., Atmospheric and Environmental Research, Inc., USA; Rodriguez, J. M., Atmospheric and Environmental

Research, Inc., USA; Hu, W., Atmospheric and Environmental Research, Inc., USA; Ko, M. K. W., Atmospheric and Environmental Research, Inc., USA; Weisenstein, D. K., Atmospheric and Environmental Research, Inc., USA; Kumer, J. B., Lockheed Martin Corp., USA; Mergenthaler, J. L., Lockheed Martin Corp., USA; Russell, J. M., III, Hampton Univ., USA; Koike, M., Nagoya Univ., Japan; Yue, G. K., NASA Langley Research Center, USA; Sep. 14, 1998; 40p; In English
Contract(s)/Grant(s): NAS5-32844; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

We present an analysis of the impact of heterogeneous chemistry on the partitioning of nitrogen species measured by the Upper Atmosphere Research Satellite (UARS) instruments. The UARS measurements utilized include: N2O, HNO3 and ClONO2 (Cryogen Limb Array Etalon Spectrometer (CLAES), version 7), temperature, methane, ozone, H2O, HCI, NO and NO2 (HALogen Occultation Experiment (HALOE), version 18). The analysis is carried out for the data from January 1992 to September 1994 in the 100-1 mbar (approximately 17-47 km) altitude range and over 10 degree latitude bins from 70 deg S to 70 deg N. Temporal-spatial evolution of aerosol surface area density (SAD) is adopted according to the Stratospheric Aerosol and Gas Experiment (SAGE) II data. A diurnal steady-state photochemical box model, constrained by the temperature, ozone, H2O, CH4, aerosol SAD and columns of O2 and O3 above the point of interest, has been used as the main tool to analyze these data. Total inorganic nitrogen (NOy) is obtained by three different methods: (1) as a sum of the UARS measured NO, NO2, HNO3, and CIONO2; (2) from the N2O-NOy correlation, (3) from the CH4-NOy correlation. to validate our current understanding of stratospheric heterogeneous chemistry for post-Pinatubo conditions, the model-calculated NOx/NOy ratios and the NO, NO2, and HNO3 profiles are compared to the UARS-derived data. In general, the UARS-constrained box model captures the main features of nitrogen species partitioning in the post-Pinatubo years. However, the model underestimates the NO2 content, particularly, in the 30-7 mbar (approximately 23-32 km) range. Comparisons of the calculated temporal behavior of the partial columns of NO2 and HNO3 and ground based measurements at 45 deg S and 45 deg N are also presented. Our analysis indicates that ground-based and HALOE v.18 measurements of the NO2 vertical columns are consistent within the range of their uncertainties and are systematically higher (up to 50%) than the model results at mid-latitudes in both hemispheres. Reasonable agreement is obtained for HNO3 columns at 45 deg S suggesting some problems with nitrogen species partitioning in the model. Outstanding uncertainties are discussed.

Author

Atmospheric Chemistry; Methane; Nitrogen; Nitrogen Oxides; Photochemical Reactions; Volcanoes; Stratosphere; Atmospheric Models; Aerosols

19990040408 State Univ. of New York, Trustees of Coumbia, New York, NY USA

Improved Upper Ocean/Sea Ice Modeling in the GISS GCM for Investigating Climate Change ***Final Report, 1 Oct. 1997 - 30 Sep. 1998***

1998; 4p; In English
Contract(s)/Grant(s): NAG5-6331; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

This project built on our previous results in which we highlighted the importance of sea ice in overall climate sensitivity by determining that for both warming and cooling climates, when sea ice was not allowed to change, climate sensitivity was reduced by 35-40%. We also modified the GISS 8 deg x lO deg atmospheric GCM to include an upper-ocean/sea-ice model involving the Semtner three-layer ice/snow thermodynamic model, the Price et al. (1986) ocean mixed layer model and a general upper ocean vertical advection/diffusion scheme for maintaining and fluxing properties across the pycnocline. This effort, in addition to improving the sea ice representation in the AGCM, revealed a number of sensitive components of the sea ice/ocean system. For example, the ability to flux heat through the ice/snow properly is critical in order to resolve the surface temperature properly, since small errors in this lead to unrestrained climate drift. The present project, summarized in this report, had as its objectives: (1) introducing a series of sea ice and ocean improvements aimed at overcoming remaining weaknesses in the GCM sea ice/ocean representation, and (2) performing a series of sensitivity experiments designed to evaluate the climate sensitivity of the revised model to both Antarctic and Arctic sea ice, determine the sensitivity of the climate response to initial ice distribution, and investigate the transient response to doubling CO2.

Derived from text

Antarctic Regions; Ocean Models; Sea Ice; Climate Change; Experiment Design; Arctic Ocean

19990040569 Department of Energy, Assistant Secretary for Energy Efficiency and Renewable Energy, Washington, DC USA

Greenhouse gas reduction by recovery and utilization of landfill methane and CO2 technical and market feasibility study, Boului Landfill, Bucharest, Romania ***Final Report, 30 Sep. 1997 - 19 Sep. 1998***

Cook, W. J., Department of Energy, USA; Brown, W. R., Department of Energy, USA; Siwajek, L., Department of Energy, USA; Sanders, W. I., Department of Energy, USA; Botgros, I., Department of Energy, USA; Sep. 30, 1998; 41p; In English
Report No.(s): DE99-000973; DOE/EE/35034-T1; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The project is a landfill gas to energy project rated at about 4 megawatts (electric) at startup, increasing to 8 megawatts over time. The project site is Boului Landfill, near Bucharest, Romania. The project improves regional air quality, reduces emission of greenhouse gases, controls and utilizes landfill methane, and supplies electric power to the local grid. The technical and economic feasibility of pre-treating Boului landfill gas with Acrion's new landfill gas cleanup technology prior to combustion for power production us attractive. Acrion's gas treatment provides several benefits to the currently structured electric generation project: (1) increase energy density of landfill gas from about 500 Btu/cu ft to about 750 Btu/cu ft; (2) remove contaminants from landfill gas to prolong engine life and reduce maintenance; (3) recover carbon dioxide from landfill gas for Romanian markets; and (4) reduce emission of greenhouse gases methane and carbon dioxide. Greenhouse gas emissions reduction attributable to successful implementation of the landfill gas to electric project, with commercial liquid CO2 recovery, is estimated to be 53 million metric tons of CO2 equivalent of its 15 year life.
NTIS
Gas Recovery; Methane; Carbon Dioxide; Air Quality; Greenhouse Effect; Pollution Control; Landfills; Exhaust Emission; Electric Generators

19990040587 Department of Energy, Office of Energy Research, Washington, DC USA
Plant nitrogen budget under elevated carbon dioxide level: Regulation by nitrogen absorption and assimilation ***Progress Report, 1 Oct. 1995 - 31 Jul. 1996***
BassiriRad, H., Department of Energy, USA; Gutschick, V., Department of Energy, USA; Dec. 31, 1998; 7p; In English
Report No.(s): DE98-007388; DOE/ER/62126-T1-PT.2; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The overall objective is to assess root physiological and morphological characteristics that may alter plant N acquisition capacity in response to rising atmospheric CO2 concentration. There is increasing evidence that plant and ecosystem responses to elevated levels of CO2 will ultimately depend on availability and acquisition rate of other resources such as N. Therefore, knowledge of any changes in root capacity to acquire N is crucial in predicting plant and ecosystem responses to high CO2. Here the authors are testing two major hypotheses: (1) elevated CO2 will enhance root N uptake kinetics and (2) CO2 enrichment will increase root preference for NO3(sup -) as opposed to NH4(sup +). High CO2 enhances root energy status which should in turn favor energy-intensive processes such as NO3(sup -) uptake and assimilation. The above hypotheses are being tested on a range of species from native and agricultural ecosystems using a combination of field, lab and growth chamber studies. The authors have demonstrated a considerable interspecies variation in root N uptake responses to CO2 enrichment and attempts are now underway to evaluate if such variations are correlated with different functional groups. A comprehensive growth model, using physiological and allocation parameters, has been largely completed and will be used to analyze the completed experimental data.
NTIS
Nitrogen; Carbon Dioxide; Absorption; Carbon Dioxide Concentration; Biological Effects; Plants (Botany)

19990040644 Southwest Research Inst., San Antonio, TX USA
Measurement of Primary Exhaust Particulate Matter Emissions from Light-Duty Motor Vehicles ***Final Report***
Whitney, K. A.; Nov. 1998; 350p; In English
Report No.(s): PB99-121279; SWRI-8427; No Copyright; Avail: CASI; A15, Hardcopy; A03, Microfiche

An in-use fleet of 60 gasoline-fueled and 8 diesel-fueled vehicles was evaluated to characterize primary particulate exhaust emissions. The candidate vehicles included light-duty passenger cars and trucks, and passenger trucks with heavy-duty engines. The six visibly smoking gasoline-fueled vehicles were chosen from a pool of over 30 smoking vehicles becuase they emitted smoke during virtually all operating conditions (idle, acceleration, deceleration, and cruise). Primary particulate exhaust emission samples were characterized for total mass emission rate, PM-10, PM-2.5, organic and elemental carbon fraction, trace elements, sulfates, nitrates, and the presence of select polynuclear aromatics, hopanes, and steranes. In addition, particle mass size distribution and particle number concentration were measured for a subset of vehicles. Gaseous and particulate exhaust emissions were evaluated using the Federal Test Procedure (FTP).
NTIS
Particulates; Exhaust Emission; Diesel Engines

19990040645 Atmospheric and Environmental Research, Inc., San Ramon, CA USA
Comparative Review of Inorganic Aerosol Thermodynamic Equilibrium Modules: Similarities, Differences, and Their Likely Causes
Zhang, Y.; Seigneur, C.; Seinfeld, J. H.; Jacobson, M.; Clegg, S. L.; Nov. 1998; 276p; In English
Report No.(s): PB99-121261; No Copyright; Avail: CASI; A13, Hardcopy; A03, Microfiche

We present a quantative evaluation of five thermodyanmic equilibrium modules that are currently used in three-dimensional (3-D) air quality PM models. The comparison is performed in stand-alone modes (i.e., outside of their 3-D host air quality models) to eliminate the influence of other atmospheric processes (e.g., gas-phase chemistry, transport and dispersion, dry and wet methods, emissions) treated in the 3-D host models. Thus, the difference in PM predictions among these modules are due solely to the differences in the model formulations and/or numerical algorithms. The modules selected for comparison include MARS-A, SEQUILIB, SCAPE2, EQUISOLV II, and AIM2.
NTIS
Particulates; Thermodynamic Equilibrium; Three Dimensional Models; Air Pollution

19990040662 NASA Goddard Space Flight Center, Greenbelt, MD USA
Aircraft NO(x) had no Unique Fingerprint on Sonex; Lightning Dominated Fresh NO(x) Sources
Thompson, A., NASA Goddard Space Flight Center, USA; Sparling, L., NASA Goddard Space Flight Center, USA; Kondo, Y., NASA Goddard Space Flight Center, USA; Anderson, B., NASA Goddard Space Flight Center, USA; Gregory, G., NASA Goddard Space Flight Center, USA; Sachse, G., NASA Goddard Space Flight Center, USA; Mar. 04, 1999; 12p; In English; Original contains color illustrations; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Key questions to which SONEX was directed were the following: Can aircraft corridors be detected? Is there a unique tracer for aircraft NO(x)? Can a ”background” NO(x) (or NO(y) be defined? What fraction of NO(x) measured during SONEX was from aircraft? How representative was SONEX of the North Atlantic in 1997 and how typical of other years? We attempt to answer these questions through species-species correlations, probability distribution functions (PDFs), and meteorological history. There is not a unique aircraft tracer, largely due to the high variability of air mass origins and tracer ratios, which render ”average” quantities meaningless. The greatest NO and NO(y) signals were associated with lightning and convective NO sources. Well-defined background CO, NO(y) and NO(y)/ozone ratio appear in subsets of two cross-track flights with subtropical origins and five flights with predominantly mid-latitude air. Forty percent of the observations on these 7 flights showed NO(y)/ozone to be above background, evidently due to unreacted NO(x). This NO(x) is a combination of aircraft, lightning and surface pollution injected by convection. The strongly subtropical signatures in SONEX observations, confirmed by pv (potential vorticity) values along flight tracks, argues for most of the unreacted NO(x) originating from lightning. Potential vorticity statistics along SONEX flight tracks in 1992-1998, and for the North Atlantic as a whole, show the SONEX meteorological environment to be representative of the North Atlantic flight corridor in the October-November period.
Author
Nitrogen Oxides; Signatures; Probability Distribution Functions; Ozone; Mass Ratios; Flight Hazards; Air Masses

19990040669 NASA Goddard Space Flight Center, Greenbelt, MD USA
Mesoscale Numerical Investigations of Air Traffic Emissions over the North Atlantic during SONEX Flight 8: A Case Study
Bieberbach, George, Jr., Florida State Univ., USA; Fuelberg, Henry E., Florida State Univ., USA; Thompson, Anne M., NASA Goddard Space Flight Center, USA; Schmitt, Alf, Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany; Hannan, John R., Florida State Univ., USA; Gregory, G. L., NASA Langley Research Center, USA; Kondo, Yutaka, Nagoya Univ., Japan; Knabb, Richard D., Florida State Univ., USA; Sachse, G. W., NASA Langley Research Center, USA; Talbot, R. W., Institute for the Study of Earth, Oceans and Space, USA; March 1999; 60p; In English; Original contains color illustrations; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

Chemical data from flight 8 of NASA’s Subsonic Assessment (SASS) Ozone and Nitrogen Oxide Experiment (SONEX) exhibited signatures consistent with aircraft emissions, stratospheric air, and surface-based pollution. These signatures are examined in detail, focussing on the broad aircraft emission signatures that are several hundred kilometers in length. A mesoscale meteorological model provides high resolution wind data that are used to calculate backward trajectories arriving at locations along the flight track. These trajectories are compared to aircraft locations in the North Atlantic Flight Corridor over a 27-33 hour period. Time series of flight level NO and the number of trajectory/aircraft encounters within the NAFC show excellent agreement. Trajectories arriving within the stratospheric and surface-based pollution regions are found to experience very few aircraft encounters. Conversely, there are many trajectory/aircraft encounters within the two chemical signatures corresponding to aircraft emissions. Even many detailed fluctuations of NO within the two aircraft signature regions correspond to similar fluctuations in aircraft encountered during the previous 27-33 hours. Results indicate that high resolution meteorological modeling, when coupled with detailed aircraft location data, is useful for understanding chemical signatures from aircraft emissions at scales of several hundred kilometers.
Author
Ozone; Time Series Analysis; Mesometeorology; Mesoscale Phenomena; High Resolution; Air Pollution; Wind Measurement

19990040674 Oak Ridge National Lab., Environmental Sciences Div., TN USA

Assessing the contribution of natural sources to regional atmospheric mercury budgets

Gustin, M. S., Oak Ridge National Lab., USA; Lindberg, S. E., Oak Ridge National Lab., USA; Dec. 31, 1997; 14p; In English; Sponsored by Electric Power Research Inst., USA

Report No.(s): DE99-000301; ORNL/CP-99786; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Contributions to the global atmospheric mercury budget originate from natural and anthropogenic sources. Constraining inputs from anthropogenic point sources has been the emphasis of past research leaving the contribution from diffuse natural and anthropogenic mercury enriched landscapes poorly constrained and underestimated. From September 1--4, 1997 mercury researchers convened in Reno, NV, US to intercompare methods used to determine in situ mercury flux from a naturally enriched landscape. Data collected indicate that naturally mercury-enriched areas constitute a significant atmospheric Hg source term. Mercury fluxes of 30 to 2,000 ng/m(exp 2) h were measured at the Steamboat springs Geothermal Area. These values are one to three orders of magnitude greater than that applied for natural sources in global mercury budgets. Air concentrations measured in the area indicate that natural sources can increase ambient levels above background concentrations. Assessment of these and other data indicate that natural sources constitute a significant source of atmospheric mercury that is available to the global mercury budget, and that the strength of the source is influenced significantly by environmental factors. Determining the contribution of mercury to the atmosphere from diffuse terrestrial sources is necessary to develop local and regional baselines for environmental regulations and risk assessments, and valid emission inventories. A scaling up mercury fluxes measured for diffuse terrestrial surfaces suggests that the natural atmospheric mercury source term in the US is comparable to the anthropogenic source term.

NTIS

Atmospheric Composition; Mercury Atmosphere; Mercury (Metal)

19990040675 Oak Ridge National Lab., TN USA

Validating CDIAC's population-based approach to the disaggregation of within-country CO2 emissions

Cushman, R. M., Oak Ridge National Lab., USA; Beauchamp, J. J., Oak Ridge National Lab., USA; Brenkert, A. L., Oak Ridge National Lab., USA; Dec. 31, 1998; 17p; In English; Global climate change; Sponsored by Department of Energy, USA

Report No.(s): DE99-000249; ORNL/CP-99776; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The Carbon Dioxide Information Analysis Center produces and distributes a data base of CO2 emissions from fossil-fuel combustion and cement production, expressed as global, regional, and national estimates. CDIAC also produces a companion data base, expressed on a one-degree latitude-longitude grid. to do this gridding, emissions within each country are spatially disaggregated according to the distribution of population within that country. Previously, the lack of within-country emissions data prevented a validation of this approach. But emissions inventories are now becoming available for most US states. An analysis of these inventories confirms that population distribution explains most, but not all, of the variance in the distribution of CO2 emissions within the US. Additional sources of variance (coal production, non- carbon energy sources, and interstate electricity transfers) are explored, with the hope that the spatial disaggregation of emissions can be improved.

NTIS

Populations; Carbon Dioxide; Emission

19990040701 California Univ., Statewide Air Pollution Research Center, Riverside, CA USA

Development and Application of an Up-to-Date Photochemical Mechanism for Airshed Modeling and Reactivity Assessment *Final Report*

Carter, W. P. L., California Univ., USA; Apr. 1998; 204p; In English

Report No.(s): PB99-123481; No Copyright; Avail: CASI; A10, Hardcopy; A03, Microfiche

The major focus of this project was the development of the Maximum Incremental Reactivity (MIR) scale which was implemented in the ARB's 'Clean Fuels/Low-Emissions Vehicle' regulations as a means to calculate ozone reactivity adjustment factors (RAF's) so that volatile organic compound (VOC) emissions from different fuel/vehicle combinations can be regulated on an equal ozone impact basis. The main body of this report documents the development of the MIR and other reactivity scales, and discusses how best to develop an optimum scale for ozone reactivity assessment for VOCs. It is concluded that the MIR scale gives similar RAFs as a scale based on effects of VOCs on integrated ozone, and that either type of scale is appropriate for applications requiring use of a single reactivity scale.

NTIS

Photochemical Reactions; Mathematical Models; Reactivity; Environment Effects; Clean Fuels

19990040769 Argonne National Lab., Energy Technology Div., IL USA

Remote detection of chemicals by millimeter-wave spectroscopy

Gopalsami, N.; Raptis, A. C.; Dec. 31, 1998; 12p; In English; 43rd; Optical science, engineering, and instrumentation

Report No.(s): DE98-058859; ANL/ET/CP-97111; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

This paper discusses the development and field testing of a remote chemical detection system that is based on millimeter-wave (mm-wave) spectroscopy. The mm-wave system is a monostatic swept-frequency radar that consists of a mm-wave sweeper, a hot-electron-bolometer detector, and a trihedral reflector. The chemical plume to be detected is situated between the transmitter/detector and the reflector. Millimeter-wave absorption spectra of chemicals in the plume are determined by measuring the swept-frequency radar return signals with and without the plume in the beam path. The problem of pressure broadening has been mitigated in this work by designing a fast sweeping source over a broad frequency range. The heart of the system is a Russian backward-wave oscillator (BWO) tube that can be tuned over 225--315 GHz. A mm-wave sweeper that includes the BWO tube was built to sweep the entire frequency range within 10 ms. The radar system was field-tested at the DOE Nevada Test Site at a standoff distance of 60 m. Methyl chloride was released from a wind tunnel that produced a 2 m diameter plume at its exit point. The mm-wave system detected methyl chloride plumes down to a concentration of 12 ppm. The measurement results agree well with model-fitted data.

NTIS

Remote Sensing; Millimeter Waves; Spectroscopy; Field Tests

19990040787 Department of Energy, Environmental Measurements Lab., New York, NY USA

Field test of the PNNL Automated Radioxenon Sampler/Analyzer (ARSA)

Lagomarsino, R. J.; Ku, E.; Latner, N.; Sanderson, C. G.; Jul. 31, 1998; 128p; In English

Report No.(s): DE99-000897; EML-597; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

As part of the requirements of the Comprehensive Test Ban Treaty (CTBT), the Automated Radioxenon/Sampler Analyzer (ARSA) was designed and engineered by the Pacific Northwest National Laboratory (PNNL). The instrument is to provide near real-time detection and measurement of the radioxenons released into the atmosphere after a nuclear test. Forty-six field tests, designed to determine the performance of the ARSA prototype under simulated field conditions, were conducted at EML from March to December 1997. This final report contains detailed results of the tests with recommendations for improvements in instrument performance.

NTIS

Field Tests; Samplers; Radiation Detectors; Xenon Isotopes

19990040821 National Health and Environmental Effects Research Lab., Western Ecology Div., Corvallis, OR USA

Carbon Emissions from Spring 1998 Fires in Tropical Mexico

Cairns, M. A.; Hao, W. M.; Alvarado, E.; Haggerty, P. K.; 1999; 20p; In English

Report No.(s): PB99-128399; EPA/600/A-99/001; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The authors used NOAA-AVHRR satellite imagery, biomass density maps, fuel consumption estimates, and a carbon emission factor to estimate the total carbon (C) emissions from the Spring 1998 fires in tropical Mexico. All eight states in southeast Mexico were affected by the wildfires, although the activity was concentrated near the common border of Oaxaca, Chiapas, and Veracruz. The fires burned approximately 482,000 ha and the land use/land cover classes most extensively impacted were the tall/medium selvas (tropical evergreen forests), open/fragmented forests, and perturbed areas. The total prompt emissions were 4.6 TgC during the two-month period of the authors' study, contributing an additional 24% to the region's average annual net C emissions from forestry and land-use change. Mexico in 1998 experienced its driest Spring since 1941, setting the stage for the widespread burning.

NTIS

Carbon; Emission; Fires; Air Pollution; Pollution Monitoring; Advanced Very High Resolution Radiometer; Satellite Imagery; Tropical Regions; Forest Management; Biomass

19990040893 NASA Goddard Space Flight Center, Greenbelt, MD USA

Atmospheric Chemical Transport Based on High Resolution Model- Derived Winds: A Case Study

Hannan, John R., Florida State Univ., USA; Fuelberg, Henry E., Florida State Univ., USA; Thompson, Anne M., NASA Goddard Space Flight Center, USA; Bieberbach, George, Jr., Florida State Univ., USA; Knabb, Richard D., Florida State Univ., USA; Kondo, Yutaka, Nagoya Univ., Japan; Anderson, Bruce E., NASA Langley Research Center, USA; Browell, Edward V., NASA Langley Research Center, USA; Gregory, Gerald L., NASA Langley Research Center, USA; Sachse, Glen, NASA Langley

Research Center, USA; Singh, Hanwant B., NASA Ames Research Center, USA; February 1999; 54p; In English; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

Flight 10 of NASA's Subsonic Assessment (SASS) Ozone and Nitrogen Oxide Experiment (SONEX) extended southwest of Lajes, Azores. A variety of chemical signatures were encountered. These signatures are examined in detail, relating them to meteorological data from a high resolution numerical model having horizontal grid spacing of 30 and 90 km and 26 vertical levels. The meteorological output at hourly intervals is used to create backward trajectories from the locations of the chemical signatures. Four major categories of chemical signatures are discussed-stratospheric, lightning, continental pollution, and a transition layer. The strong stratospheric signal is encountered just south of the Azores in a region of depressed tropopause height. Three chemical signatures at different altitudes in the upper troposphere are attributed to lightning. Backward trajectories arriving at locations of these signatures are related to locations of cloud-to-ground lightning. Results show that the trajectories pass through regions of lightning 1-2 days earlier over the eastern Gulf of Mexico and off the southeast coast of the USA. The lowest leg of the flight exhibits a chemical signature consistent with continental pollution. Trajectories arriving at this signature are found to pass over the highly populated Northeast Corridor of the United States. Surface based pollution apparently is lofted to the altitudes of the trajectories by convective clouds along the East Coast that did not contain lightning. Finally, a chemical transition layer is described. Its chemical signature is intermediate to those of lightning and continental pollution. Trajectories arriving in this layer pass between the trajectories of the lightning and pollution signatures. Thus, they probably are impacted by both sources.
Author

Meteorological Parameters; Stratosphere; Tropopause; Troposphere; Atmospheric Chemistry; Global Air Pollution; Air Pollution; Pollution Transport; Atmospheric Circulation

19990040974 San Francisco State Univ., Dept. of Chemistry and Biochemistry, CA USA

Direct Sampling Ion Trap Mass Spectrometry: A New Tool for Environmental Monitoring

Palmer, Peter T., San Francisco State Univ., USA; Proceedings from the 1998 Occupational Health Conference: Benchmarking for Excellence; February 1999, pp. 51-53; In English; See also 19990040967; No Copyright; Avail: CASI; A01, Hardcopy; A03, Microfiche

The recent development of a collection of techniques referred to as direct sampling ion trap mass spectrometry (DSITMS) shows great promise for real-time, high-throughput, low-cost screening of environmental pollutants in air. One of its great strengths is the flexibility it allows the user in choosing among different sample introduction systems, ionization modes, and scan modes. This presentation delineates the various stages involved in a DSITMS analysis, describes the options and great flexibility inherent in each of these stages, and demonstrates the use of DSITMS techniques for monitoring trace levels of volatile organic compounds (VOCs) in Mir space station air samples.
Author

Environmental Monitoring; Air Sampling; Indoor Air Pollution; Mass Spectroscopy; Ion Traps (Instrumentation)

19990041001 Bionetics Corp., Cocoa Beach, FL USA

Potential Impact of Local Fauna on Employees at the Kennedy Space Center

Martin, George A., Bionetics Corp., USA; Arnold, Arthur A., Jr., Bionetics Corp., USA; Proceedings from the 1998 Occupational Health Conference: Benchmarking for Excellence; February 1999, pp. 158; In English; See also 19990040967; No Copyright; Avail: CASI; A01, Hardcopy; A03, Microfiche

The John F. Kennedy Space Center is home to the 150,000 acre Merritt Island National Wildlife Refuge. This refuge has the largest number of threatened or endangered species on the continental USA, as well as hundreds of other species of animals. With over 15,000 employees engaged in numerous operations scattered throughout the wildlife refuge, there are ample opportunities for interactions with potentially hazardous species. This poster presentation examined many of these unique occupational hazards. The primary thrust of this presentation was to highlight the unique interactions that can occur between the world of the high tech, and that of the wild. Even though there was no systematic study of fauna-related injuries to Kennedy Space Center workers, several areas of potential investigation were demonstrated, which could lay the groundwork for future studies.
Derived from text

Industrial Safety; Safety Management; Animals

19990041012 Edgerton, Germeshausen and Grier, Inc., Cocoa Beach, FL USA

Identification and Prioritization of Work Place Processes with Physical and Chemical Hazards at Kennedy Space Center and Cape Canaveral Air Station

Sherwood, John D., Edgerton, Germeshausen and Grier, Inc., USA; Proceedings from the 1998 Occupational Health Conference:

Benchmarking for Excellence; February 1999, pp. 191-194; In English; See also 19990040967; No Copyright; Avail: CASI; A01, Hardcopy; A03, Microfiche

The Industrial Hygiene (IH) Office initiated new procedures in fiscal year 1998 to identify and categorize work places at Kennedy Space Center (KSC) and Cape Canaveral Air Station (CCAS) which have processes where personnel may have a potential for exposure to physical and/or chemical hazards. The main drivers behind these procedures were to allow for more efficient utilization of manpower and to offer better service to our customers.

Derived from text

Industrial Safety; Toxic Hazards; Operational Hazards; Noise (Sound); Exposure

19990041018 Bessa (Sharon J.) and Associates, Inc., Middleton, WI USA

Resolution of Indoor Air Quality Problems: The Human Side

Bessa, Sharon J., Bessa (Sharon J.) and Associates, Inc., USA; Proceedings from the 1998 Occupational Health Conference: Benchmarking for Excellence; February 1999, pp. 212-225; In English; See also 19990040967; No Copyright; Avail: CASI; A03, Hardcopy; A03, Microfiche

The types of problems seen in indoor air quality investigations in the 1990's are not new. Similar complaints and events have occurred in the past. Investigators' approaches have often been too simplistic with the underlying cause considered to be either strictly psychological or environmental. The history and evolution of the problem, stages of indoor air quality progression and methods of resolution are presented.

Derived from text

Indoor Air Pollution; Group Dynamics; Problem Solving

19990041044 NASA Marshall Space Flight Center, Huntsville, AL USA

Interactive Sectoring and Animation of Global Change Data

Meyer, Paul J., Global Hydrology and Climate Center, USA; Buillory, Anthony R., NASA Marshall Space Flight Center, USA; Atkinson, Robert J., Lockheed Martin Corp., USA; Jedlovec, Gary J., NASA Marshall Space Flight Center, USA; 1999; In English; 15th; IIPS for Meteorology, Oceanography and Hydrology, 10-15 Jan. 1999, Dallas, TX, USA; Sponsored by American Meteorological Society, USA; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

In order to analyze and share results of global change data sets, scientists require a venue in which to exchange their results. One appropriate medium for these collaborative efforts is the world wide web. Intuitive and efficient user interfaces, and background processes have been developed at the Global Hydrology and Climate Center to interactively view weather satellite, radar, global temperature anomaly, and model output data using the world wide web. These tools combine scripts, Java and C code which allows the user to easily interact with data, to create high resolution sector images, and sectored animation sequences. This paper examines the architecture and interfaces and how they are used for collaborative research.

Author

Computer Programs; Data Processing; Java (Programming Language); Hydrology; Climatology; Anomalies

19990041050 NASA Ames Research Center, Moffett Field, CA USA

Resilience: Concepts and Measures, Chapter 2

Westman, Walter E., NASA Ames Research Center, USA; Resilience in Mediterranean-Type Ecosystems; 1986, pp. 5-19; In English; ISBN 90-6193-579-2; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

Inertia, the resistance of an ecosystem property to change under stress, is distinguished from resilience, which refers to the degree, manner. and pace of change or recovery in ecosystem properties following disturbance. In turn, these two terms are differentiated from 'stability'. which is used here to refer to the pattern of natural fluctuation in ecosystem properties in the absence of major exogenous disturbance. Four component attributes of resilience are reviewed in the context of Mediterranean-climate examples. The elasticity component concerns the rate of recovery of an ecosystem property following disturbance; amplitude, the threshold of stress beyond which recovery to the initial state does not occur; hysteresis, the degree to which the pattern of recovery after stress differs from that of deterioration under chronic stress, and malleability the ease with which the ecosystem can become permanently altered. Each ecosystem property will typically reveal a different level of resilience to a given stress and stressor. The degree of recovery should not be expected to be complete in any event, due to sample variability and stochastic events. In cyclicallystable ecosystems, the pattern of recovery should be measured in light of this periodicity, and short-term (within-cycle) recovery distinguished from long-term (between-cycle) recovery. The prediction of resilience properties of ecosystems can be approached through a knowledge of the modular structure of foodwebs, through knowledge of the autecological adapta-

tions of key species to the stressor, or through cumulative experience of the response to disturbance at the community level. At present there is much room for investigation of each of these approaches in Mediterranean-climate ecosystems.
Author
Ecosystems; Elastic Properties; Climate; Periodic Variations; Research

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GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism. For space radiation see 93 Space Radiation.

19990039121 Department of Energy, Office of Energy Research, Washington, DC USA
Multistation magnetotellurics ***Final Report, 1 Jan. 1996 - 30 Jun. 1997***
Egbert, G. D., Department of Energy, USA; Dec. 31, 1997; 79p; In English
Report No.(s): DE98-006118; DOE/ER/14595-T1; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The author has developed the foundations of a practical multivariate approach to processing magnetotelluric array data. Compared to current standards for magnetotelluric data processing, the multivariate approach is unique in that all available data channels are used simultaneously. The approach is outlined in this report. Using Multmtrn, a program for multiple station analysis of magnetotelluric data, the author achieved significant improvements in apparent resistivity and phase estimates in initial tests. Examples of the use of this approach are given including: Carrizo Plain and Parkfield electromagnetic profiling data; sea floor magnetotelluric (MT) data from the Gulf of Mexico; MT survey in a culturally noisy area of Bavaria; and Parkfield/Hollister earthquake monitoring array data. Experience with these projects has resulted in an improved program.
NTIS
Magnetic Surveys; Multivariate Statistical Analysis; Data Processing; Channels (Data Transmission); Computer Programs

19990039168 NASA Goddard Space Flight Center, Greenbelt, MD USA
The Tropical Upper Troposphere and Lower Stratosphere in the GEOS-2 GCM
Pawson, S., Universities Space Research Association, USA; Takacs, L., General Sciences Corp., USA; Molod, A., General Sciences Corp., USA; Nebuda, S., General Sciences Corp., USA; Chen, M., General Sciences Corp., USA; Rood, R., NASA Goddard Space Flight Center, USA; Read, W. L., Jet Propulsion Lab., California Inst. of Tech., USA; Fiorino, M., Lawrence Livermore National Lab., USA; 1999; 9p; In English
Contract(s)/Grant(s): NAS5-98181; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The structure of the tropical upper troposphere and lower stratosphere in the GEOS-2 General Circulation Model (GCM) is discussed. The emphasis of this study is on the reality of monthly-mean temperature and water vapor distributions in the model, compared to reasonable observational estimates. It is shown that although the zonal-mean temperature is in good agreement with observations, the GCM supports an excessive zonal asymmetry near the tropopause compared to the ECMWF Reanalyses. In reality there is a QBO-related variability in the zonally averaged lower stratospheric temperature which is not captured by the model. The observed upper tropospheric temperature and humidity fields show variations related to those in the sea surface temperature, which are not incorporated in the GCM; nevertheless, there is some interannual variability in the GCM, indicating a component arising from internal processes. The model is too moist in the middle troposphere (500 hPa) but too dry in the upper troposphere, suggesting that there is too little vertical transport or too much drying in the GCM. Transport into the stratosphere shows a pronounced annual cycle, with drier air entering the tropical stratosphere when the tropopause is coldest in northern winter; while the alternating dry and moist air masses can be traced ascending through the tropical lower stratosphere, the progression of the anomalies is too rapid.
Author
Troposphere; Tropical Regions; Stratosphere; Circulation Distribution; Research; Atmospheric General Circulation Models

19990039172 NASA Marshall Space Flight Center, Huntsville, AL USA
Relationship of Topside Ionospheric Ion Outflows to Auroral Forms and Precipitation, Plasma Waves, and Convection Observed by Polar
Hirahara, M., Alabama Univ., USA; Horwitz, J. L., Alabama Univ., USA; Moore, T. E., NASA Marshall Space Flight Center, USA; Germany, G. A., Alabama Univ., USA; Spann, J. F., NASA Marshall Space Flight Center, USA; Peterson, W. K., Lockheed Martin Missiles and Space, USA; Shelley, E. G., Southwest Research Inst., USA; Chandler, M. O., NASA Marshall Space Flight Center, USA; Giles, B. L., NASA Marshall Space Flight Center, USA; Craven, P. D., NASA Marshall Space Flight Center, USA;

Pollock, C. J., Southwest Research Inst., USA; Gurnett, D. A., Iowa Univ., USA; Pickett, J. S., Iowa Univ., USA; Persoon, A. M., Iowa Univ., USA; Scudder, J. D., Iowa Univ., USA; Maynard, N. C., Mission Research Corp., USA; Mozer, F. S., California Univ., USA; Brittnacher, M. J., Washington Univ., USA; Nagai, T., Tokyo Inst. of Tech., Japan; Journal of Geophysical Research; Aug. 01, 1998; ISSN 0148-0227; Volume 103, No. A8, pp. 17,391-17,410; In English; Original contains color illustrations
Contract(s)/Grant(s): NAS8-38145; NAS5-30302; NAS8-38145; NAS8-38146; NAS5-30371; NAS5-30367; NAS8-38189; NAG8-114; NAG8-693; NAG5-3182; SwRI Proj. 15-9455; GGS Proj. UDN 370-17-43
Report No.(s): Paper-97JA02668; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

The POLAR satellite often observes upflowing ionospheric ions (UFIs) in and near the aurora] oval on southern perigee (approx. 5000 km altitude) passes. We present the UFI features observed by the thermal ion dynamics experiment (TIDE) and the toroidal imaging mass angle spectrograph (TIMAS) in the dusk-dawn sector under two different geomagnetic activity conditions in order to elicit their relationships with auroral forms, wave emissions, and convection pattern from additional POLAR instruments. During the active interval, the ultraviolet imager (UVI) observed a bright discrete aurora on the duskside after the substorm onset and then observed a small isolated aurora form and diffuse auroras on the dawnside during the recovery phase. The UFIs showed clear conic distributions when the plasma wave instrument (PWI) detected strong broadband wave emissions below approx. 10 kHz, while no significant auroral activities were observed by UVI. At higher latitudes, the low-energy UFI conics gradually changed to the polar wind component with decreasing intensity of the broadband emissions. V-shaped auroral kilometric radiation (AKR) signatures observed above -200 kHz by PWI coincided with the region where the discrete aurora and the UFI beams were detected. The latitude of these features was lower than that of the UFI conics. During the observations of the UFI beams and conics, the lower-frequency fluctuations observed by the electric field instrument were also enhanced, and the convection directions exhibited large fluctuations. It is evident that large electrostatic potential drops produced the precipitating electrons and discrete auroras, the UFI beams, and the AKR, which is also supported by the energetic plasma data from HYDRA. Since the intense broadband emissions were also observed with the UFIs, the ionospheric ions could be energized transversely before or during the parallel acceleration due to the potential drops.
Author
Ionospheric Ion Density; Auroras; Plasma Waves; Convection; Electron Precipitation

19990039183 Royal Netherlands Meteorological Inst., Seismology Dept., De Bilt, Netherlands
Seismic risk in Northern Netherlands ***Seismisch Risico in Noord-Nederland***
deCrook, T., Royal Netherlands Meteorological Inst., Netherlands; Haak, H. W., Royal Netherlands Meteorological Inst., Netherlands; Dost, B., Royal Netherlands Meteorological Inst., Netherlands; February 1998; ISSN 0169-1708; In Dutch
Report No.(s): KNMI-TR-205; ISBN 90-369-2138-4; Copyright; Avail: Issuing Activity (KNMI, P.O. Box 201, 3730 AE De Bilt, Wilhelminalaan 10, The Netherlands), Hardcopy, Microfiche

During the last ten years, the public, press, government, and industry have again posed the question of the seismic risk of earthquakes in Northern Netherlands. Above all, after greater shocks occurred, the seismic risk was again timely. Examples are the earthquakes in Eleveld in 1991 and 1992, in Alkmaar in 1994, and the most recent one in Roswinkel in 1997. In a series of reports based on the material available at that time, the KNMI has given a clear, unbiased answer to the question of the size of the seismic risk. The first seismic risk analyses of earthquakes in Northern Netherlands are described in Haak, et al. (1993, 1994); see also the final report of the Supervisory Commission on Earthquake Research (BOA) from 1993. These analyses were based on the first 24 tremors observed in December 1986. In the report by De Crook, et al. (1995), the first 56 tremors are analyzed.
Derived from text
Earthquakes; Risk; Netherlands

19990039184 Royal Netherlands Meteorological Inst., De Bilt, Netherlands
Macroseismic Observations Roswinkel 2/19/97 ***Macroseismische Waarneminger Roswinkel 19-2-1997***
Dost, B., Royal Netherlands Meteorological Inst., Netherlands; Haak, H. W., Royal Netherlands Meteorological Inst., Netherlands; 1997; ISSN 0169-1708; In Dutch
Report No.(s): KNMI-TR-199; ISBN 90-369-2125-2; Copyright; Avail: Issuing Activity (KNMI, PO Box 201, 3730 AE De Bilt, Wilhelminalaan 10, De Bilt, The Netherlands), Hardcopy, Microfiche

The KNMI conducted an investigation within the population of Roswinkel and the surrounding area with regard to the earthquake of 2/19/97. This earthquake was the largest of a series of up to 13 earthquakes in the area of Roswinkel and measured 3.4 on the Richter scale. The purpose of the investigation was to map out the area where the effects of the earthquake were noticed. The greatest intensity (I(sub o)) is measured in the epicenter. The intensity decreases the farther away one travels from the epicenter. The intensity data is pertinent for an independent determination of the depth of the earthquake, which cannot be determined accurately from the information by the borehole seismometers. Additionally, the determination of the contour of intensity IV is

important for the evaluation of the possible damage to the earth's surface. It should be noted that the earthquake struck at the same time a storm raged, a storm with a wind force of 7 on the Beaufort scale. It had gusts of up to a wind force 9, which also could cause damage and whereby the weakest tremors probably were not noticed.
Derived from text
Seismographs; Earthquakes; Damage; Storms; Tremors

19990040221 Air Force Inst. of Tech., School of Engineering, Wright-Patterson AFB, OH USA
Validation of the Gallagher Protonospheric Model
Law, Kelly M.; Mar. 1999; 123p; In English
Report No.(s): AD-A361355; AFIT/GAP/ENP/99M-04; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

Ionospheric models are used in many systems throughout the Department of Defense: for example, they are useful in correcting range errors in radio signals. However, correction models don't incorporate the protonosphere, the torus-shaped plasma volume above the ionosphere. The Gallagher Protonospheric Model, recently incorporated into the Parameterized Ionospheric Model 1.7 (PIM 1.7), was validated against protonospheric total electron content (PTEC) measurements made by the GPS system. Gallagher model calculations of slant PTEC for Pittsburgh ground station looking south with a raypath at an elevation of 26 degrees were compared against GPS PTEC measurements for the same configuration derived from the Dual Station Technique (DST). In the DST, 11 days of GPS TEC measurements were obtained from Charleston and Pittsburgh, taking advantage of the latitudinal asymmetry of the protonosphere to obtain PTEC. The Gallagher model results were in general agreement with measured PTEC, indicating a slight diurnal change in PTEC (less than 2 PTEC). Groundtmth PTEC accuracy was estimated at 2-3.5 PTEC, masking any trend measurement, yet good enough to validate the potential of Self Calibration of Pseudo-range Errors (SCORE) and DST to measure PTEC using GPS. PIM 1.7 users should be aware of Gallagher's limits: empirical, limited to 00-10 Magnetic Local Time, and +1-40 degrees geomagnetic latitude.
DTIC
Global Positioning System; Atmospheric Models; Electron Density (Concentration); Plasmas (Physics); Earth Ionosphere; Proving

19990040539 Department of Energy, Office of Energy Research, Washington, DC USA
Growth of a tectonic ridge
Fleming, R. W., Department of Energy, USA; Messerich, J. A., Department of Energy, USA; Johnson, A. M., Department of Energy, USA; Dec. 31, 1997; 97p; In English
Report No.(s): DE99-000965; USGS-OFR-97-153; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The 28 June 1992 Landers, California, earthquake of M 7.6 created an impressive record of surface rupture and ground deformation. Fractures extend over a length of more than 80 km including zones of right-lateral shift, steps in the fault zones, fault intersections and vertical changes. Among the vertical changes was the growth of a tectonic ridge described here. In this paper the authors describe the Emerson fault zone and the Tortoise Hill ridge including the relations between the fault zone and the ridge. They present data on the horizontal deformation at several scales associated with activity within the ridge and belt of shear zones and show the differential vertical uplifts. And, they conclude with a discussion of potential models for the observed deformation.
NTIS
Earthquakes; Tectonics; Fractures (Materials); Geological Faults; Seismic Waves

19990040548 Northwest Research Associates, Inc., Bellevue, WA USA
Investigation of Tropical Transport with UARS Data ***Final Report***
Dunkerton, Timothy J., Northwest Research Associates, Inc., USA; Mar. 05, 1999; 71p; In English; Original contains color illustrations
Contract(s)/Grant(s): NAS5-32862
Report No.(s): NASA/CR-1999-209210; NAS 1.26:209210; NWRA-CR-99-R195; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

Measurements of trace constituents obtained by instruments aboard the Upper Atmosphere Research Satellite (UARS) have been used to study transport processes associated with the quasi-biennial oscillation, laterally propagating Rossby waves, and upward propagating Kelvin waves in the tropical and subtropical upper troposphere and stratosphere. Mean vertical motions, vertical diffusivities and in-mixing rates were inferred from observations of the 'tape recorder' signal in near-equatorial stratospheric water vapor. The effect of the quasi-biennial oscillation (QBO) on tracer distributions in the upper half of the stratosphere was seen in a spectacular 'staircase' pattern, predominantly in the winter hemisphere, revealing the latitudinally asymmetric nature of QBO transport due to induced mean meridional circulations and modulation of lateral mixing associated with planetary Rossby

waves. The propagation of Rossby waves across the equator in the westerly phase of the QBO was seen in tracer fields and corroborating UK Meteorological Office (UKMO) analyses; a modeling study of the effect of these waves on typical QBO wind profiles was performed. Water vapor in the upper troposphere and lower stratosphere was found to exhibit signatures of the tropical intraseasonal oscillation (TIO) and faster Kelvin waves in the two regions, respectively.
Author
Stratosphere; Tropical Regions; Vertical Motion; Wave Propagation; Planetary Waves; Rossby Regimes; Kelvin Waves; Troposphere; Tropical Meteorology; Atmospheric Circulation

19990040626 Iowa Univ., Dept. of Physics and Astronomy, Iowa City, IA USA
Foreshock Langmuir Waves for Unusually Constant Solar Wind Conditions: Data and Implications for Foreshock Structure
Cairns, Iver H., Iowa Univ., USA; Robinson, P. A., Sydney Univ., Australia; Anderson, Roger R., Iowa Univ., USA; Strangeway, R. J., California Univ., USA; Journal of Geophysical Research; Nov. 01, 1997; ISSN 0148-0227; Volume 102, No. A11, pp. 24,249-24,264; In English
Contract(s)/Grant(s): NAGw-2040
Report No.(s): Paper-97JA02168; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

Plasma wave data are compared with ISEE 1's position in the electron foreshock for an interval with unusually constant (but otherwise typical) solar wind magnetic field and plasma characteristics. For this period, temporal variations in the wave characteristics can be confidently separated from sweeping of the spatially varying foreshock back and forth across the spacecraft. The spacecraft's location, particularly the coordinate D(sub f) downstream from the foreshock boundary (often termed DIFF), is calculated by using three shock models and the observed solar wind magnetometer and plasma data. Scatterplots of the wave field versus D(sub f) are used to constrain viable shock models, to investigate the observed scatter in the wave fields at constant D(sub f), and to test the theoretical predictions of linear instability theory. The scatterplots confirm the abrupt onset of the foreshock waves near the upstream boundary, the narrow width in D(sub f) of the region with high fields, and the relatively slow falloff of the fields at large D(sub f), as seen in earlier studies, but with much smaller statistical scatter. The plots also show an offset of the high-field region from the foreshock boundary. It is shown that an adaptive, time-varying shock model with no free parameters, determined by the observed solar wind data and published shock crossings, is viable but that two alternative models are not. Foreshock wave studies can therefore remotely constrain the bow shock's location. The observed scatter in wave field at constant D(sub f) is shown to be real and to correspond to real temporal variations, not to unresolved changes in D(sub f). by comparing the wave data with a linear instability theory based on a published model for the electron beam it is found that the theory can account qualitatively and semiquantitatively for the abrupt onset of the waves near D(sub f) = 0, for the narrow width and offset of the high-field region, and for the decrease in wave intensity with increasing D(sub f). Quantitative differences between observations and theory remain, including large overprediction of the wave fields and the slower than predicted falloff at large D(sub f) of the wave fields. These differences, as well as the unresolved issue of the electron beam speed in the high-field region of the foreshock, are discussed. The intrinsic temporal variability of the wave fields, as well as their overprediction based on homogeneous plasma theory, are indicative of stochastic growth physics, which causes wave growth to be random and varying in sign, rather than secular.
Author
Plasma Waves; Solar Wind; Magnetic Fields; Plasma Physics; Langmuir Turbulence; Shock Waves; Mathematical Models

19990040635 Finnish Geodetic Inst., Masala, Finland
Gravity Measurements of Estonia
Sildvee, Heldur, Finnish Geodetic Inst., Finland; 1998; ISSN 0355-1962; 12p; In English; Original contains color illustrations; ISBN 951-711-221-1; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The present paper gives a review of gravity measurements performed in Estonia as well as of manuscript or printed gravity maps. Only gravity maps covering the whole territory of Estonia are considered. Regional gravity surveys were performed by V. Maasik, Institute of Geology of the Estonian Academy of Sciences, in 1949-1958. The aim of measurements was to compile a gravity map at scale 1:200,000. In small areas of Northern and Central Estonia detail surveys at scales 1:25,000 and 1:50,000 were carried out in 1960-1995 by the Estonian Board of Geology (currently Geological Survey of Estonia) for geological purposes. Up to 1991 all gravity measurements and map production in Estonia were governed by the standards of the Soviet Union and these works were highly confidential. The gravity measurements in Estonia can be divided into three periods: 1949-1960, 1961-1990, and 1991-1997. Before World War II, in 1939/40, the gravity acceleration had been measured in Estonia only at 99 stations (Maasik, 1976; Sildvee, 1993). The base station, measured inl930 by H. Schmehl and E. Andersen, was located in Tallinn, in the

basement of Toomkooli Street no. 9. Today these measurements are only of historical significance. Major gravity works started after the wax in 1949.
Author
Gravitation; Estonia; Geological Surveys

19990040672 Oak Ridge National Lab., Center for Engineering Systems Advanced Research, TN USA
Parallelization of the acoustic wave equation with absorbing boundary conditions
White, C. T., Oak Ridge National Lab., USA; Protopopescu, V. A., Oak Ridge National Lab., USA; Barhen, J., Oak Ridge National Lab., USA; Jul. 31, 1998; 24p; In English; Sponsored by Department of Energy, USA
Report No.(s): DE99-000322; ORNL/TM-13373; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Many practical problems involve wave propagation through atmosphere, oceans, or terrestrial crust. Modeling and analysis of these problems is usually done in (semi)infinite domains, but numerical calculations obviously impose restriction to finite domains. to mimic the actual behavior in the (semi)infinite medium, artificial absorbing boundary conditions are imposed at the boundaries, whereby waves can only exit, but not enter the finite computational domain. Efficient absorbing boundary conditions are difficult to analyze and costly to run. In particular, it is of interest to assess whether the wave equation with (approximate or exact) absorbing boundary conditions admits a suitable diagonalization. This would open the possibility for parallelizing many important numerical codes used in applications. In this paper the authors propose a set of stable, local, absorbing boundary conditions for the discrete acoustic wave equation. They show that the acoustic wave equation with absorbing boundary conditions cannot be exactly diagonalized.
NTIS
Wave Equations; Boundary Conditions; Wave Propagation; Sound Waves; Parallel Processing (Computers)

19990040691 Los Alamos National Lab., NM USA
New perspectives on substorm injections
Reeves, G. D.; Dec. 31, 1998; 7p; In English; ICS-4: substorms
Report No.(s): DE99-000775; LA-UR-98-2083; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

There has been significant progress in understanding substorm injections since the Third International Conference on Substorms in 1996. Progress has come from a combination of new theories, quantitative modeling, and observations--particularly multi-satellite observations. There is now mounting evidence that fast convective flows are the mechanism that directly couples substorm processes in the mid tail, where reconnection occurs, with substorm processes the inner magnetosphere where Pi2 pulsations, auroral breakups, and substorm injections occur. This paper presents evidence that those flows combined with an earthward-propagating compressional wave are responsible for substorm injections and discusses how that model can account for various substorm injection signatures.
NTIS
Injection; Magnetic Storms

19990040694 Los Alamos National Lab., NM USA
Storm/substorm signatures in the outer belt
Korth, A.; Friedel, R. H. W.; Mouikis, C.; Fennell, J. F.; Dec. 31, 1998; 8p; In English; ICS-4: substorms
Report No.(s): DE99-000756; LA-UR-98-2123; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The response of the ring current region is compared for periods of storm and substorm activity, with an attempt to isolate the contributions of both processes. The authors investigate CRRES particle data in an overview format that allows the display of long-term variations of the outer radiation belt. They compare the evolution of the ring current population to indicators of storm (Dst) and substorm (AE) activity and examine compositional changes. Substorm activity leads to the intensification of the ring current at higher L (L approximately 6) and lower ring current energies compared to storms (L approximately 4). The O(+)/H(+) ratio during substorms remains low, near 10%, but is much enhanced during storms (can exceed 100%). They conclude that repeated substorms with an AE approximately 900 nT lead to a (Delta)Dst of approximately 30 nT, but do not contribute to Dst during storm main phase as substorm injections do not form a symmetric ring current during such disturbed times.
NTIS
Signatures; Outer Radiation Belt; Magnetic Storms

19990040837 NASA Goddard Space Flight Center, Greenbelt, MD USA

The Crustal Dichotomy Boundary West of Tempe Terra: Speculation on Where it Lies Beneath Alba Patera Based on Mola Topography

Frey, H., NASA Goddard Space Flight Center, USA; Roark, J., Science Systems and Applications, Inc., USA; Sakimoto, S., Universities Space Research Association, USA; McGovern, P., Carnegie Institution of Washington, USA; 1999; 2p; In English; Lunar Planetary Sciences, 15-18 Mar. 1999, Houston, TX, USA; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

MOLA gridded data based on profiles collected during the Aerobraking Hiatus and Science Phasing Operations suggest the crustal dichotomy boundary west of Tempe continues beneath Alba volcanics, at least to 105 W at about 50 N. A broad shelf-like region in the Alba units is continuous with a similar region of Tempe in which Hesperian volcanics overlie Noachian cratered terrain. Perspective views show significant changes in the sloping character of the flanks of Alba east and west of 105W, with much more continuous steep topography to the west. We suggest that Alba sits astride the ancient crustal dichotomy boundary, not adjacent to it, and that its eastern half lies on old cratered terrain. If true, this would significantly affect the estimate of Alba volcanics volumes, and might also explain some of the observed asymmetries in the structure and the distribution of faults associated with this immense feature.

Author

Dichotomies; Crusts; Boundaries; Topography

19990040892 NASA Goddard Space Flight Center, Greenbelt, MD USA

Clear-Sky UV-B trends over Northern Midlatitudes derived from TOMS Low-Reflectivity Footprint Measurements

Ziemke, Jerry, NASA Goddard Space Flight Center, USA; Chandra, Sushil, NASA Goddard Space Flight Center, USA; Varotsos, C., Athens Univ., Greece; 1998; 20p; In English; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This study investigates the distribution of clear-sky ultraviolet-B (UV-B, wavelengths 290-320 nm) trends in northern midlatitudes using 1979-1991 Nimbus 7 total ozone mapping spectrometer (TOMS) version 7 low-reflectivity (Rless than 0.2) total ozone footprint measurements. The incorporation of essentially cloud-free ozone data from TOMS provides a direct method for separating transient cloud effects from anthropogenic and other dynamical factors present in UV-B. This study has also included both National Oceanic and Atmospheric Administration (NOAA) microwave sounding unit channel 4 (MSU4) and National Centers for Environmental Prediction (NCEP) 500 hPa temperature (T500) fields in our trend models to improve UV-Index (UVI) trend statistics and to investigate the effects of interannual changes in UVI caused by synoptic-scale (horizontal wavelengths 4000-8000 km) and planetary-scale (horizontal wavelengths greater than 8000 km) dynamical events. Clear-sky UVI trends in the northern midlatitudes show large increases (exceeding 10 % per decade) and distinct regional variability especially during winter-spring months which can be attributed to topography and dynamical forcing effects. In the UV-important summer-autumn months, these trends are more uniformly distributed and still statistically significant, although smaller at around +2 to +3 % per decade. Specifically, during April largest increases in midlatitude UVI are seen to extend from near the dateline eastward across North America. In June months largest UVI increases occur over the east Asian continent with values around +5 to +6 % per decade. These increases in UVI over both the Pacific and Asian continent regions persist through summer into Autumn. In the the European sector, statistically significant increases in clear-sky UVI are found over central Europe with values around +2 to +3 % per decade and +8 to +9 % per decade during summer and winter-spring months, respectively. Over the nearby Mediterranean region these seasonal trends are around +2 to +3 and +5 to +6 % per decade.

Author

Ozone; Ultraviolet Radiation; Solar Radiation; Ozone Depletion; Central Europe

19990040935 California Inst. of Tech., Div. of Geological and Planetary Sciences, Pasadena, CA USA

Hydrogen Radicals, Nitrogen Radicals, and the Production of O3 in the Upper Troposphere

Wennberg, P. O., California Inst. of Tech., USA; Hanisco, T. F., California Inst. of Tech., USA; Jaegle, L., California Inst. of Tech., USA; Jacob, D. J., California Inst. of Tech., USA; Hintsa, E. J., California Inst. of Tech., USA; Lanzendorf, E. J., California Inst. of Tech., USA; Anderson, J. G., California Inst. of Tech., USA; Gao, R.-S., California Inst. of Tech., USA; Keim, E. R., California Inst. of Tech., USA; Donnelly, S. G., California Inst. of Tech., USA; DelNegro, L. A., California Inst. of Tech., USA; Fahey, D. W., California Inst. of Tech., USA; McKeen, S. A., California Inst. of Tech., USA; Salawitch, R. J., California Inst. of Tech., USA; Webster, C. R., California Inst. of Tech., USA; May, R. D., California Inst. of Tech., USA; Herman, R. L., California Inst. of Tech., USA; Proffitt, M. H., California Inst. of Tech., USA; Margitan, J. J., California Inst. of Tech., USA; Atlas, E. L., California Inst. of Tech., USA; Science; Jan. 02, 1998; Volume 279, pp. 49-53; In English; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

The concentrations of the hydrogen radicals OH and HO2 in the middle and upper troposphere were measured simultaneously with those of NO, O3, CO, H2O, CH4, non-methane hydrocarbons, and with the ultraviolet and visible radiation field. The data

allow a direct examination of the processes that produce O3 in this region of the atmosphere. Comparison of the measured concentrations of OH and HO2 with calculations based on their production from water vapor, ozone, and methane demonstrate that these sources are insufficient to explain the observed radical concentrations in the upper troposphere. The photolysis of carbonyl and peroxide compounds transported to this region from the lower troposphere may provide the source of HO, required to sustain the measured abundances of these radical species. The mechanism by which NO affects the production of O3 is also illustrated by the measurements. In the upper tropospheric air masses sampled, the production rate for ozone (determined from the measured concentrations of HO2 and NO) is calculated to be about I part per billion by volume each day. This production rate is faster than previously thought and implies that anthropogenic activities that add NO to the upper troposphere, such as biomass burning and aviation, will lead to production of more 03 than expected.
Author
Hydrogen; Radicals; Nitrogen; Upper Atmosphere; Troposphere; Radiation Distribution; Light (Visible Radiation); Carbonyl Compounds; Measuring Instruments

19990040942 Oak Ridge National Lab., TN USA
Determining effective soil formation thermal properties from field data using a parameter estimation technique
Shonder, J. A.; Beck, J. V.; Dec. 31, 1998; 50p; In English; Sponsored by American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc., USA
Report No.(s): DE99-000227; ORNL/CP-99428; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

A one-dimensional thermal model is derived to describe the temperature field around a vertical borehole heat exchanger (BHEx) for a geothermal heat pump. The inlet and outlet pipe flows are modeled as one, and an effective heat capacity is added to model the heat storage in the fluid and pipes. Parameter estimation techniques are then used to estimate various parameters associated with the model, including the thermal conductivity of the soil and of the grout which fills the borehole and surrounds the u-tube. The model is validated using test data from an experimental rig containing sand with known thermal conductivity. The estimates of the sand thermal conductivity derived from the model are found to be in good agreement with independent measurements.
NTIS
Soils; Thermodynamic Properties; Estimating

19990041058 National Inst. of Polar Research, Tokyo, Japan
JARE Data Reports, Number 233, Upper Atmosphere Physics 16: Upper Atmosphere Physics Data Obtained at Syowa Station in 1996
Kawana, Sachihito, National Inst. of Polar Research, Japan; Kikuchi, Masayuki, National Inst. of Polar Research, Japan; Sakanoi, Takeshi, National Inst. of Polar Research, Japan; Yumisashi, Isamu, National Inst. of Polar Research, Japan; Taguchi, Makoto, National Inst. of Polar Research, Japan; Mar. 1998; ISSN 0075-3343; 202p; In English; Copyright; Avail: Issuing Activity (National Inst. of Polar Research, Tokyo, Japan), Hardcopy, Microfiche

This data book summarizes upper atmosphere physics data acquired by the 37th Japanese Antarctic Research Expedition (JARE-37) with the ”Upper Atmosphere Physics Monitoring (UAPM) System” at Syowa Station in 1996, Observation items are as follows: 1. Geomagnetism: (a) H-, D- and Z-components of magnetic variations. (b) Total force of the geomagnetic field. (c) H-, D- and Z-components of magnetic pulsations. 2. ELF-VLF wave: (a) Intensities at 0.35, 0.75, 1.2, 2, 4, 8, 30, 60 and 95 kHz. (b) Wide-band (0- IO kHz) signal of ELF-VLF emissions. 3. Ionosphere: (a) Cosmic noise absorption at 30 MHz observed with a broad-beam riometer. 4. Aurora: (a) All-sky cameras: (1) Film type: (a) Panchromatic images recorded on color films. (b) Scanning photometers: (1) Meridian-scanning record at the folloaing three wavelengths 557.7 nm (OI), 630.0 nm (OI) and 486.1 nm (H(sub beta)). An outline of the observation system is given in Section 2. Section 3 describes specifications of the observation instruments and the data acquisition systems. Observation periods are also listed in Section 3. Format of the compiled digital data is shown in Section 4. Summary plots in the period of January 1 - December 31, 1996 are given in Appendix. All-sky camera observation data, magnetograms an summary plots of the monitoring data are available to users on request.
Derived from text
Upper Atmosphere; Atmospheric Physics; Data Acquisition; Digital Data; Magnetic Signatures; Magnetic Variations

19990041078 NASA Goddard Space Flight Center, Greenbelt, MD USA
A Digital Tectonic Activity Map of the Earth
Lowman, Paul, NASA Goddard Space Flight Center, USA; Masuoka, Penny, NASA Goddard Space Flight Center, USA; Montgomery, Brian, NASA Goddard Space Flight Center, USA; OLeary, Jay, NASA Goddard Space Flight Center, USA; Salisbury, Demetra, NASA Goddard Space Flight Center, USA; Yates, Jacob, NASA Goddard Space Flight Center, USA; Mar. 17, 1999;

15p; In English; Original contains color illustrations; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The subject of neotectonics, covering the structures and structural activity of the last 5 million years (i.e., post-Miocene) is a well-recognized field, including "active tectonics," focussed on the last 500,000 years in a 1986 National Research Council report of that title. However, there is a cartographic gap between tectonic maps, generally showing all features regardless of age, and maps of current seismic or volcanic activity. We have compiled a map intended to Bridge this gap, using modern data bases and computer-aided cartographic techniques. The maps presented here are conceptually descended from an earlier map showing tectonic and volcanic activity of the last one million years. Drawn by hand with the National Geographic Society's 1975 "The Physical World" map as a base, the 1981 map in various revisions has been widely reproduced in textbooks and various technical publications. However, two decades of progress call for a completely new map that can take advantage of new knowledge and cartographic techniques. The digital tectonic activity map (DTM), presented in shaded relief (Fig. 1) and schematic (Fig. 2) versions, is the result. The DTM is intended to show tectonism and volcanism of the last one million years, a period long enough to be representative of global activity, but short enough that features such as fault scarps and volcanos are still geomorphically recognizable. Data Sources and Cartographic Methods The DTM is based on a wide range of sources, summarized in Table 1. The most important is the digital elevation model, used to construct a shaded relief map. The bathymetry is largely from satellite altimetry, specifically the marine gravity compilations by Smith and Sandwell (1996). The shaded relief map was designed to match the new National Geographic Society world physical map (1992), although drawn independently, from the digital elevation model. The Robinson Projection is used instead of the earlier Van der Grinten one. Although neither conformal nor equal-area, the Robinson Projection provides a reasonable compromise and retains useful detail at high latitudes.

Derived from text

Tectonics; Maps; Volcanology; Relief Maps; Digital Data

19990041079 California Univ., Los Angeles, CA USA

Design Study for a Global Magnetospheric Dynamics Mission ***Final Report, 1 Mar. 1997 - 28 Feb. 1999***

Russell, C. T., California Univ., USA; 1999; 7p; In English

Contract(s)/Grant(s): NAG5-3880; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

A successful design was developed, one with many advantages over the original mission. The time spent in orbit was more evenly spread over the region being investigated. The radiation close was significantly lower and the mission did not rely on gravity assist at the moon and thus did not have to make measurements that far out in the tail. A spacecraft design was developed that keeps interference from the engines to a minimum. The design however was quite specific for four spacecraft. It could not be easily scaled to five spacecraft for example. One problem was discovered that is a concern for all similar missions. Inter- spacecraft communication can determine the spacing of the vehicles easily and to the accuracy required. However, the orientation of the polyhedron with the spacecraft at its vertices is not well known for small separations. Ground station range measurements give the line of sight location well but not the angle around that vector. This is a problem any such mission needs to solve. Neither the navigation teams at Goddard nor at Lewis were willing to attempt to solve this problem. At the completion of the study a report was made to the AGU meeting in San Francisco and a paper published in the volume "Science Closure and Enabling Technologies for Constellation Class Missions". This paper is attached.

Derived from text

Design Analysis; Technologies; Research and Development; Gravitation; Spacecraft Design; Planetary Magnetospheres

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METEOROLOGY AND CLIMATOLOGY

Includes weather forecasting and modification.

19990039093 Air Force Inst. of Tech., School of Engineering, Wright-Patterson AFB, OH USA

An Improved Thunderstorm Forecast Index For Cape Canaveral, Florida ***Final Report***

Everitt, James A.; Mar. 1999; 111p; In English

Report No.(s): AD-A361423; AFIT/GM/ENP/99M-06; No Copyright; Avail: Issuing Activity (Defense Technical Information Center (DTIC)), Microfiche

This thesis creates a new algorithm to replace the Neumann-Pfeffer Thunderstorm Index (NPTI). The 45th Weather Squadron at Patrick AFB, Florida, uses the NPTI as an objective means of determining the probability of thunderstorm occurrence at Cape Canaveral. The probability is used for mission planning and resource protection, and increasing the accuracy of NPTI can potentially save billions of dollars for the USA space program. Stratified logistical regressions are performed and probability equations are derived for May through September using upper air data and surface observations for Cape Canaveral. A logistical regression

of NPTI was also performed. Variables include combinations of the climatological frequency of thunderstorms, the conditional probability of thunderstorms, the u and v components of the 850 mb, 700 mb, and 600 mb winds, the 800 mb to 600 mb mean relative humidity, the K index, and the Thompson index. The two resulting algorithms are compared to NPTI and persistence, and are evaluated based on their ability to forecast thunderstorms correctly. The primary performance metrics used to evaluate the algorithms are hit rate, threat score, probability of detection, false alarm rate, Brier skill score, and ratio skill score. The investigation results indicate that the new algorithms are suitable for use by the 45th Weather Squadron and are an improvement on NPTI. The results show that the best algorithm, Stratified Logistic Thunderstorm Index (STLI), has a 57% better hit rate, a 51 % better threat score, and a 68% better probability of detection than NPTI. In Addition STLI shows a 59% lower false alarm rate than NPTI. Because of the significant improvement over NPTI, the algorithm should be prepared for operational use at Patrick AFB.
DTIC
Thunderstorms; Climatology; Mission Planning; Weather Forecasting

19990039100 Air Force Inst. of Tech., Wright-Patterson AFB, OH USA
Forecasting Downdraft Wind Speeds Associated with Airmass Thunderstorms for Peterson Air Force Base, Colorado, Using the WSR-88D
Steen, Travis A.; Mar. 1999; 139p; In English
Report No.(s): AD-A361414; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

During the period Jun-Aug 96, four Air Force installations suffered over $4.8 million in damage from convective winds. During the same summer, Air Force Space Command units issued nearly 65% of their weather warnings for convective winds, making the forecasting of convective winds the most frequent challenge to forecasters. This thesis seeks to assist Air Force forecasters at Peterson Air Force Base (PAFB), Colorado, in forecasting airmass thunderstorm downdraft wind speeds using the Weather Surveillance Radar-1988 Doppler (WSR-88D). To accomplish this purpose, several existing potential downdraft wind speed prediction techniques were evaluated against the observed wind speeds of nineteen airmass thunderstorms. The nineteen airmass thunderstorms studied accounted for all airmass thunderstorms occurring within 10.5 run of PAFB from 1 Apr-30 Sep 96 and 1 Apr-30 Sep 97 and for which archived WSR-88D data was available. The results of the evaluations suggested the prediction techniques in operational use are not accurate m forecasting downdraft wind speeds at PAFB. Moreover, it was discovered during this research that the technique developed by the Air Force's Air Weather Service (AWS) to predict wind gust potential has no scientific basis and its use by Air Force forecasters should be discontinued. A statistical analysis of these prediction techniques using WSR-88D data collected from the airmass thunderstorms provided no accurate means by which to statistically modify these techniques for application at PAFB. Finally, 112 regression models were developed and tested to identify a possible relationship between WSR-88D
DTIC
Weather Forecasting; Wind Velocity; Prediction Analysis Techniques; Meteorological Radar; Gusts; Thunderstorms

19990039103 Air Force Inst. of Tech., Wright-Patterson AFB, OH USA
Improving Cape Canaveral's Next-Day Thunderstorm Forecasting Using a Meso-ETA Model-Based Index
Crane, John C.; Mar. 1999; 98p; In English
Report No.(s): AD-A361411; AFIT/GM/ENP/99M-4; No Copyright; Avail: CASI; A05, Hardcopy; A02, Microfiche

Reliable thunderstorm forecasts are essential to safety and resource protection at Cape Canaveral. Current methods of forecasting day-2 thunderstorms provide little improvement over forecasting by persistence alone and are therefore in need of replacement. This research focused on using the mesoscale eta model to develop an index for improved forecasting of day-2 thunderstorms. Logistic regression techniques were used to regress the occurrence of a thunderstorm at Cape Canaveral against day-2 forecast variables output, or derived, from the mesoscale eta model. Accuracy and bias scores were calculated for the forecasts made by the regression equations, and the forecast results were compared to persistence and to model-based forecasts of the Neumann-Pfeffer Thunderstorm Index (NPTI). For cases where the results were shown to be statistically significant, the forecasts made using the logistic regression equations (called the Eta Thunderstorm Index (ETI)) consistently outperformed both persistence and the NPTI. Due to the small sample size used in this research, further study on this topic is encouraged.
DTIC
Forecasting; Indexes; Thunderstorms; Mesoscale Phenomena

19990039104 Air Force Inst. of Tech., Dept. of Engineering Physics, Wright-Patterson AFB, OH USA
Using the WSR-88D to Forecast Downburst Winds at Cape Canaveral Air Station and the Kennedy Space Center (CCAS/KSC)
Sullivva, Gerald D.; Mar. 1999; 111p; In English

Report No.(s): AD-A361409; AFIT/GM/ENP/99M-12; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

The 45 Weather Squadron is tasked with providing several convective wind warnings in support of the U. S. Space Program. The forecasters use a radar-based forecast technique to determine if a thunderstorm has the potential to produce a gust that meets warning criteria. This technique, the Echo Top/Vertically Integrated Liquid Wind Gust Potential (ET/VIL WGP), has not previously been evaluated for use in the Cape Canaveral Air Station and Kennedy Space Center (CCAS/KSC) locale. Additionally, there are two other radar-based forecast techniques that required evaluation for possible inclusion into the 45 WS forecast process. These are the Maximum Reflectivity Height of Maximum Reflectivity (d/H) Wind Gust Potential and the Storm Top/Vertically Integrated Liquid (STVIL) Wind Gust Potential techniques. Radar data from 15 pulse-type storms that occurred in the CCAS/KSC locale were collected. Potential wind gust forecasts were calculated using the techniques mentioned above. The forecast and observed wind gusts were analyzed using visual and numerical tools to assess the performance of the WGP techniques. Results of the research indicated that the WGP techniques could not consistently predict the magnitude of the downburst gust. The average errors of the prediction were on the order of 10 knots and were quite variable. Because of the small sample size, these results can not be considered as conclusive; however, they may indicate that these techniques do not display the degree of accuracy required to be used operationally by the 45 WS.

DTIC

Weather Forecasting; Gusts; Wind Velocity

19990039173 Institute for Global Change Research and Education, Huntsville, AL USA

A Quantitative Investigation of Entrainment and Detrainment in Numerically Simulated Convective Clouds, Pt. 1, Model Development

Cohen, Charles, Institute for Global Change Research and Education, USA; November 1998; 35p; In English

Contract(s)/Grant(s): NCC8-142; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A method is developed which uses numerical tracers to make accurate diagnoses of entraimnent and detrainment rates and of the properties of the entrained and detrained air in numerically simulated clouds. The numerical advection scheme is modified to make it nondispersive, as required by the use of the tracers. Tests of the new method are made, and an appropriate definition of clouds is selected. Distributions of mixing fractions in the model consistently show maximums at the end points, for nearly undilute environmental air or nearly undilute cloud air, with a uniform distribution between. The cumulonimbus clouds simulated here entrain air that had been substantially changed by the clouds, and detrained air that is not necessarily representative of the cloud air at the same level.

Author

Convection; Cumulonimbus Clouds; Entrainment; Mathematical Models; Atmospheric Models; Environment Simulation; Advection; Dispersing

19990039178 Air Force Inst. of Tech., School of Engineering, Wright-Patterson AFB, OH USA

Evaluation of Barnes' Method and Kriging for Estimating the Low Level Wind Field ***Final Report***

Engel, Michael W.; Mar. 03, 1999; 124p; In English

Report No.(s): AD-A361455; AFIT/GM/ENP/99M-05; No Copyright; Avail: Issuing Activity (Defense Technical Information Center (DTIC)), Microfiche

This thesis evaluates two different methods of estimating a three dimensional wind field based upon a limited number of irregularly-spaced observations. This work was performed for the 45th Weather Squadron to determine how well the two methods worked and their potential for use in a visualization program. The two methods evaluated were Barnes' method and a method called Kriging, which is commonly used in geostatistics. Both of these estimation techniques were implemented and then evaluated to determine how accurate the estimates were that they created. The methods' accuracies were determined by withholding an observation from the observed wind field data set, performing the estimation, and then comparing the estimated value at the point of the withheld observation with the actual value withheld. These performance results were compared to determine which method produced a more accurate estimated wind field. Barnes' method proved to be the less complicated to implement, but Kriging provided a more accurate estimate. Both of the methods had a significant amount of estimation error associated with them. This large error casts serious doubt on their abilities to produce an accurate enough estimation to be useful in analyzing the low-level wind field.

DTIC

Wind Velocity; Velocity Distribution; Kriging; Estimating

19990039179 Air Force Inst. of Tech., School of Engineering, Wright-Patterson AFB, OH USA

A Validation Study of Cloud Scene Simulation Model Temporal Performance ***Final Report***

Kerr, Glenn; Mar. 1999; 112p; In English

Report No.(s): AD-A361453; AFIT/GM/ENP/99M-08; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

Cloud Scene Simulation Model (CSSM) temporal performance was validated by comparing the cloud forcing signatures on observed radiometric time series with those derived from CSSM output for initial conditions similar to that for the observed data. Observed radiometric data was collected by a normal incidence pyraheliometer sensitive to wavelengths in the range .3mm to 3mm. Simulation radiometric time series data was derived by applying the following process to each case study. CSSM cloud liquid water content (CLWC) grids were converted to grids of slant path optical depth values by the Fast Map post processor to the CSSM. A ray tracing routine then integrated the slant path optical depth values along a path from the position of the sun through each cloud volume to a point at its base. The position of the sun was fixed by ephemeris calculations for the time and location of the case study. The integrated optical depth values were then used with a modified form of Beer's Law to derive radiometric time series values. Subjective and statistical comparison of the observed and corresponding simulation time series data were then made. The statistical comparison used correlograms, variograms and power law analyses to determine whether CSSM cloud field evolution with time proceeded in a realistic manner. Results indicate that CSSM cloud fields do not evolve in a realistic manner. Radiometric traces derived from simulation data lack small scale variations present in the observed data, while large scale variations in the simulation data are exaggerated.

DTIC

Fractals; Computerized Simulation; Cloud Physics; Clouds (Meteorology); Atmospheric Models

19990039181 Air Force Inst. of Tech., School of Engineering, Wright-Patterson AFB, OH USA

A Refinement and Cross-Validation of the Special Sensor Microwave Imager (SSM/I) Calibration-Validation (CV) Brightness Temperature Algorithm ***Final Report***

Adair, Mark R.; Mar. 01, 1999; 104p; In English; Sponsored in part by Air Force Weather Agency (AFWA)

Report No.(s): AD-A361450; AFIT/GM/ENP/99M-01; No Copyright; Avail: Issuing Activity (Defense Technical Information Center (DTIC)), Microfiche

The Air Force Weather Agency (AFWA) currently uses an algorithm to calculate surface temperatures from microwave observations taken by the Special Sensor Microwave Imager (SSM/I) aboard the orbiting platforms of the Defense Meteorological Satellite Program (DMSP). This algorithm, called the Calibration-Validation (CV) algorithm, used multiple linear regression to calculate coefficients relating microwave brightness temperatures and land surface temperatures. Because the coefficients in this algorithm do not take into account the identity of the individual satellite, the question arose whether this assumption was valid. This thesis used multiple linear regression, stepwise linear regression, and qualitative regression on 3700 data sets from October of 1996 and September of 1997, including microwave brightness temperatures from three satellites. This data was analyzed to determine if satellite identity had a significant impact on CV regression coefficients. Analysis indicated that satellite identity does not have a significant impact on regression coefficients for five of the eight CV land types investigated. Analysis of two CV land types indicated data set identity had a significant impact, while there was insufficient data to determine the impact for one CV land type. In addition to the qualitative regression, stepwise linear regression was performed on five land type categories using combined data for all satellites. Regressed RMSEs ranged from 2.825 K to 3.743 K, while R squared values ranged from .7295 to .8613. Preliminary analysis indicated refinement of CV brightness temperature coefficients might yield better accuracy for the algorithm.

DTIC

Microwave Imagery; Calibrating; Brightness Temperature; Algorithms

19990039549 Air Force Inst. of Tech., School of Engineering, Wright-Patterson AFB, OH USA

Estimating the Height of the Planetary Boundary Layer for Diffusion-Transport Models: A Four Algorithm Comparison ***Final Report***

Russ, Robert L.; Mar. 01, 1999; 151p; In English

Report No.(s): AD-A361458; AFIT/GM/ENP/99M-09; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche

Diffusion-Transport (D-T) modeling is a branch of numerical weather prediction concerned with eddy diffusion of particulate pollutant plumes and their transport by the wind. When conducting D-T modeling, establishing the height of the planetary boundary layer (PBL) is crucial to defining the vertical bounds within which a plume can become thoroughly mixed. The PBL can be deduced from observations or model simulation. Three sounding analysis PBL algorithms were considered - the Potential Instability Mixing Depth (PIMIX), Potential Temperature (POTEMP), and Gradient Richardson Number (RICH) algorithms. A turbulent kinetic energy (TKE) based PBL algorithm was also evaluated. The purpose of this research was threefold. First, observed atmo-

spheric soundings were input, and algorithm output was compared to human analyses of the observed soundings (Analysis). Second, Regional Atmospheric Modeling System (RAMS) generated forecast soundings were input, and algorithm output was compared to human analyses of the forecast soundings (Simulation). Finally, algorithm output from simulation was compared with the human analyses from analysis (Verification). These PBL comparisons were put into one of four categories: (1) hit, (2) indication of deep convection, (3) miss, or (4) algorithm failure. Algorithm performance was ranked based on the number of hits, then on indications of deep convection. PIMIX was the best analysis tool, while both POTEMP and TKE were the best simulation methods. All algorithms had a similar number of hits for verification, but PIMIX had more estimates indicative of deep convection, so was ranked best.
DTIC
Atmospheric Models; Planetary Boundary Layer

19990039555 Air Force Inst. of Tech., School of Engineering, Wright-Patterson AFB, OH USA
A Comparison of Horizontal Cloud-to-Ground Lightning Flash Distance Using Weather Surveillance Radar and The Distance Between Successive Flashes Method ***Final Report***
Cox, Christopher C.; Mar. 1999; 147p; In English
Report No.(s): AD-A361389; AFIT/GM/ENP/99M-03; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

On April 29th, 1996 an airman servicing a C-130 aircraft on Huriburt AFB Florida was struck and killed by a lightning flash that traveled an estimated 7 to 10 miles from storms south of the airfield. Ten other workers were injured in the incident. The fatal flash occurred just 8 minutes after the base weather station allowed a lightning advisory to expire. The incident brought to question the adequacy of lightning advisory criteria. Very little research has been done on the horizontal distance that cloud-to-ground lightning flashes occurs from the center of a thunderstorm. This thesis used the WSR-88D method, which used the WSR-88D Algorithm Testing and Display System (WATADS) to calculate the distance from a lightning flash to a thunderstorm centroid. The WSR-88D method was compare with a lightning spatial and temporal clustering method known as the Distance Between Successive Flashes (DBSF) method. This method can use enormous amounts of lightning data, and is well suited to accomplish a climatology of horizontal flash distance from a lightning centroid. For the combined April and July 1996 data used in this thesis, the average percentage of lightning flashes that occurred beyond the 5 nautical mile lightning safety radius outlined in AFOSH 91-100 for both the WSR-88D method and the DBSF method was 30.86%. This result questions the adequacy of the 5 nautical mile lightning safety distance criterion currently being used at most USA Air Force Bases for protection both life and property.
DTIC
Lightning; Range; Thunderstorms; C-130 Aircraft

19990039559 Air Force Inst. of Tech., School of Engineering, Wright-Patterson AFB, OH USA
Predicting Launch Pad Winds at the Kennedy Space Center With a Neural Network Model
Storch, Steven J.; Mar. 1999; 72p; In English
Report No.(s): AD-A361368; AFIT/GM/ENP/99M-11; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

This thesis uses neural networks to forecast winds at the Kennedy Space Center and the Cape Canaveral Air Station launch pads. Variables are developed from WINDS tower observations, surface and buoy observations, and an upper-air sounding. From these variables, a smaller set of predictive inputs is chosen using a signal-to-noise variable screening method. A neural network is then trained to forecast launch pad winds from the inputs. The network forecasts are compared to persistence, and peak wind predictions are found skillful compared to persistence. An ensemble modeling technique using Toth's and Kalnay's breeding of growing modes method is explored with neural networks. The inputs are perturbed an amount representative of measurement error. Ensemble member forecasts are found to diverge, but the ensemble spread does not often encompass the resulting weather. This is due to a disproportionate amount of error originating from the model compared to error originating from measurements.
DTIC
Neural Nets; Weather Forecasting; Wind (Meteorology)

19990039626 Department of Energy, Washington, DC USA
Numerical Weather Forecasting at the Savannah River Site
Buckley, R. L., Department of Energy, USA; Dec. 31, 1998; 4p; In English; Sponsored by American Nuclear Society, USA
Report No.(s): DE98-058036; WSRC-MS-98-00233; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

This paper discusses the use of an advanced three-dimensional prognostic numerical model to provide space and time-dependent meteorological data for use in the WIND System dispersion models.
NTIS
Weather Forecasting; Climate Models; Wind (Meteorology); Three Dimensional Models; Rivers

19990039656 NASA Goddard Space Flight Center, Greenbelt, MD USA
A Study of the December 1992 Westerly Wind Burst Event during TOGA COARE
Chen, Chaing, NASA Goddard Space Flight Center, USA; Tao, Wei-Kuo, NASA Goddard Space Flight Center, USA; Duffy, Dean G., NASA Goddard Space Flight Center, USA; Lai, George S., NASA Goddard Space Flight Center, USA; Lin, Po-Hsiung, National Taiwan Univ., Taiwan, Province of China; February 1999; 44p; In English; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Using the Penn State/NCAR MM5 mesoscale model, a westerly wind burst (WWB) that occurred during the period from 19 to 30 December 1992 over the Tropical Ocean Global Atmosphere Coupled Ocean-Atmosphere Response Experiment (TOGA COARE) has been simulated and compared with observation. This event is characterized by the presence of super cloud clusters and the occurrence of a major WWB that extended over the western and central Pacific Ocean. Although several of the observed convective systems were not precisely simulated by MM5, the model did capture many other observed characteristics, such as the explosive development of convection, the cyclonic circulation and the WWB. The WWB resulted from the coalescence of three types of tropical disturbances. The first type was a low-level westerly jet (LWJ) that developed at the equator and may be associated with the eastward propagation of an ISO (Intraseasonal Oscillation). The second type featured an easterly wave-like disturbance that originated in the south central Pacific Ocean and propagated westward. Finally, the third type involved a cross-equatorial flow that deflected Northern Hemispheric easterlies into the Southern Hemisphere and may be caused by inertial instability. These disturbances worked in concert, resulting in intense convection over the TOGA COARE region. Once intense convection developed, a large-scale circulation was produced over the western Pacific warm pool, propagated eastward, and initiated a WWB.
Author
Mesoscale Phenomena; Tropical Regions; Air Water Interactions; Cross Flow; Jet Streams (Meteorology); Lower Atmosphere; Wind (Meteorology)

19990040206 NASA Goddard Space Flight Center, Greenbelt, MD USA
Seasonal and Interannual Variations of Evaporation and their Relations with Precipitation, Net Radiation, and Net Carbon Accumulation for the Gediz Basin Area
Choudhury, Bhaskar J., NASA Goddard Space Flight Center, USA; 1999; 23p; In English; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A model combining the rate of carbon assimilation with water and energy balance equations has been run using satellite and ancillary data for a period of 60 months (January 1986 to December 1990). Calculations for the Gediz basin area give mean annual evaporation as 395 mm, which is composed of 45% transpiration, 42% soil evaporation and 13% interception. The coefficient of interannual variation of evaporation is found to be 6%, while that for precipitation and net radiation are, respectively, 16% and 2%, illustrating that net radiation has an important effect in modulating interannual variation of evaporation. The mean annual water use efficiency (i.e., the ratio of net carbon accumulation and total evaporation) is ca. 1 g/sq m/mm, and has a coefficient of interannual variation of 5%. A comparison of the mean water use efficiency with field observations suggests that evaporation over the area is utilized well for biomass production. The reference crop evaporation for irrigated areas has annual mean and coefficient of variation as, respectively, 1176 mm and 3%. The total evaporation during three summer months of peak evaporation (June-August) is estimated to be about 575 mm for irrigated crops like maize and cotton. Seasonal variations of the fluxes are presented.
Author
Annual Variations; Biomass; Estimating; Satellite Observation; Carbon

19990040413 Federal Aviation Administration, Technical Center, Atlantic City, NJ USA
Operational Test and Evaluation (OT&E) Test Plan for the Federal Aviation Administration (FAA) Bulk Weather Telecommunications Gateway (FBWTG)
Khatiwala, Bart; Benner, William E.; DiMassa, Gerald; Jan. 1999; 42p; In English
Report No.(s): AD-A361248; DOT/FAA/CT-TN-99/2; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The Federal Aviation Administration (FAA) Bulk Weather Telecommunications Gateway (FBWTG) is a communications gateway to the FAA for high-resolution gridded weather forecast data (e.g., Eta Forecast Model, Aviation (AVN) and Rapid Update Cycle (RUC) and airborne observation data (e.g., Meteorological Data Collection and Reporting System (MDCRS)) from

the National Weather Service Telecommunications Gateway (NWSTG). The FBWTG will provide the capability to simultaneously and continuously receive high-resolution gridded weather forecast data and MDCRS data from the NWSTG and disseminate this information to other National Airspace System (NAS) subsystems. The purpose of this plan is to provide an overview of the Operational Test and Evaluation (OT&E) phase of System Testing for both pathways; NWSTG to FBWTG located at the Air Traffic Control System Command Center (ATCSCC), and FBWTG to National Weather Service (NWS) Filter Unit (NFU)-Test device located at the William J. Hughes Technical Center. to accomplish this objective, the FBWTG, an end-state subsystem, must be operationally integrated with NAS subsystems. This plan establishes test strategy, test objectives, test criteria, and detailed test and evaluation descriptions to be used in the generation of the Test Procedures and Test Report's entrance and exit criteria for the program.
DTIC
Air Traffic Control; Weather Forecasting; Meteorological Parameters

19990040663 Institute for Global Change Research and Education, Huntsville, AL USA
A Quantitative Investigation of Entrainment and Detrainment in Numerically Simulated Convective Clouds, Pt. 2, Simulations of Cumulonimbus Clouds
Cohen, Charles, Institute for Global Change Research and Education, USA; November 1998; 33p; In English
Contract(s)/Grant(s): NCC8-142; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Deep cumulonimbus clouds are simulated using a model that makes accurate diagnoses of entrainment and detrainment rates and of the properties of entrained and detrained air. Clouds generated by a variety of initial thermodynamic soundings are compared. In the simulations, updraft entrainment rates are large near and above cloud base, through the entire depth of the conditionally unstable layer. Stronger updrafts in a more unstable environment are better able to entrain relatively undisturbed environmental air, while weaker updrafts can entrain only air that has been modified by the clouds. When the maximum buoyancy is large, the updraft includes parcels with a wide range of buoyancies, while weaker clouds are more horizontally uniform. Strong downdrafts originate from levels at which updrafts detrain, and their mass flux depends on the mass flux of the updraft. The magnitude of mixing between cloud and environment, not the entrainment rate, varies inversely with the cloud radius. How much of the mixed air is entrained depends on the buoyancy.
Author
Entrainment; Cumulonimbus Clouds; Simulation; Vertical Air Currents; Diagnosis; Thermodynamics

19990040666 NASA Goddard Space Flight Center, Greenbelt, MD USA
Wind Stress Forcing of the North Sea "Pole Tide"
OConnor, William P., National Oceanic and Atmospheric Administration, USA; Chao, Benjamin Fong, NASA Goddard Space Flight Center, USA; Zheng, Dawei, Academia Sinica, China; Au, Andrew Y., Raytheon STX Corp., USA; 1998; 36p; In English; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

We conducted numerical simulations of the wind-forcing of the sea level variations in the North Sea using a barotropic ocean model with realistic geography, bathymetry, and boundary conditions, to examine the forcing of the 14-month "pole tide" which is known to be strong along the Denmark- Netherlands coast. The simulation input is the monthly-mean surface wind stress field from the National Centers for Environmental Prediction (NCEP) reanalysis for the 40-year period 1958-1997. The output sea level response was then compared with 10 coastal tide gauge records from the Permanent Service for Mean Sea Level (PSMSL). Besides the strong seasonal variations, several prominent quasi-periodicities exist at around 7 years, 3 years, 14 months, 9 months, and 6.5 months. Correlation and spectral analyses show remarkable agreement between the model output and the observations, particularly in the 14-month, or Chandler period band. The latter indicates that the enhanced pole tide found in the North Sea along the Denmark-Netherlands coast is actually the coastal setup response to wind stress forcing with a periodicity of 14 months. We find no need to invoke a geophysical explanation involving resonance-enhancement of pole tide in the North Sea to explain the observations.
Author
Marine Meteorology; Simulation; Wind Shear; Barotropism; Geography; Boundary Conditions; Tides; Stress Distribution; Ocean Models

19990040667 NASA Goddard Space Flight Center, Greenbelt, MD USA
The Sensitivity of Tropical Squall Lines (GATE and TOGA COARE) to Surface Fluxes: Cloud Resolving Model Simulations
Wang, Yansen, NASA Goddard Space Flight Center, USA; Tao, Wei-Kuo, NASA Goddard Space Flight Center, USA; Simpson, Joanne, NASA Goddard Space Flight Center, USA; Lang, Stephen, NASA Goddard Space Flight Center, USA; Feb. 24, 1999;

37p; In English; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Two tropical squall lines from TOGA COARE and GATE were simulated using a two-dimensional cloud-resolving model to examine the impact of surface fluxes on tropical squall line development and associated precipitation processes. The important question of how CAPE in clear and cloudy areas is maintained in the tropics is also investigated. Although the cloud structure and precipitation intensity are different between the TOGA COARE and GATE squall line cases, the effects of the surface fluxes on the amount of rainfall and on the cloud development processes are quite similar. The simulated total surface rainfall amount in the runs without surface fluxes is about 67% of the rainfall simulated with surface fluxes. The area where surface fluxes originated was categorized into clear and cloudy regions according to whether there was cloud in the vertical column. The model results indicated that the surface fluxes from the large clear air environment are the dominant moisture source for tropical squall line development even though the surface fluxes in the cloud region display a large peak. The high-energy air from the boundary layer in the clear area is what feeds the convection while the CAPE is removed by the convection. The surface rainfall was only reduced 8 to 9% percent in the simulations without surface fluxes in the cloud region. Trajectory and water budget analysis also indicated that most moisture (92%) was from the boundary layer of the clear air environment.

Author

Cloud Physics; Simulation; Tropical Regions; Precipitation (Meteorology); Convection; Clouds (Meteorology); Atmospheric Models

19990040774 NASA Langley Research Center, Hampton, VA USA

Prelaunch Calibrations of the Clouds and the Earth's Radiant Energy System (CERES) Tropical Rainfall Measuring Mission and Earth Observing System Morning (EOS-AM1) Spacecraft Thermistor Bolometer Sensors

Lee, Robert B., III, NASA Langley Research Center, USA; Barkstrom, Bruce R., NASA Langley Research Center, USA; Bitting, Herbert C., TRW Space and Electronics Group, USA; Crommelynck, Dominique A. H., Institut Royal Meteorologique de Belgique, Belgium; Paden, Jack, Science Applications International Corp., USA; Pandey, Dhirendra K., Science Applications International Corp., USA; Priestley, Kory J., NASA Langley Research Center, USA; Smith, G. Louis, Virginia Polytechnic Inst. and State Univ., USA; Thomas, Susan, Science Applications International Corp., USA; Thornhill, K. Lee, Science Applications International Corp., USA; Wilson, Robert S., Science Applications International Corp., USA; IEEE Transactions on Geoscience and Remote Sensing; July 1998; ISSN 0196-2892; Volume 36, No. 4, pp. 1173-1185; In English; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

The Clouds and the Earth's Radiant Energy System (CERES) spacecraft scanning thermistor bolometer sensors measure earth radiances in the broadband shortwave solar (O.3 - 5.0 micron and total (0.3 to 100 microns) spectral bands as well as in the 8-12 microns water vapor window spectral band. On November 27, 1997, the launch of the Tropical Rainfall Measuring Mission (TRMM) spacecraft placed the first set of CERES sensors into orbit, and 30 days later, the sensors initiated operational measurements of the earth radiance fields. In 1998, the Earth Observing System morning (EOS-AM1) spacecraft will place the second and third sensor sets into orbit. The prelaunch CERES sensors' count conversion coefficients (gains and zero-radiance offsets) were determined in vacuum ground facilities. The gains were tied radiometrically to the International Temperature Scale of 1990 (ITS-90). The gain determinations included the spectral properties (reflectance, transmittance, emittance, etc.) of both the sources and sensors as well as the in-field-of-view (FOV) and out-of-FOV sensor responses. The resulting prelaunch coefficients for the TRMM and EOS-AM1 sensors are presented. Inflight calibration systems and on-orbit calibration approaches are described, which are being used to determine the temporal stabilities of the sensors' gains and offsets from prelaunch calibrations through on-orbit measurements. Analyses of the TRMM prelaunch and on-orbit calibration results indicate that the sensors have retained their ties to ITS-90 at accuracy levels better than /- 0.3% between the 1995 prelaunch and 1997 on-orbit calibrations.

Author

Calibrating; Earth Observing System (EOS); Radiance; Radiant Flux Density; Spectral Reflectance; Temperature Scales; Water Vapor; Thermistors; Bolometers

19990040835 NASA Marshall Space Flight Center, Huntsville, AL USA

Localized Upper Tropospheric Warming During Tropical Depression and Storm Formation Revealed by the NOAA-15 AMSU

Spencer, Roy W., NASA Marshall Space Flight Center, USA; Braswell, William D., Nichols Research Corp., USA; 1999; 4p; In English, 10-15 Jan. 1999, Dallas, TX, USA; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

The warm core of hurricanes as measured by microwave temperature sounders has been related to various azimuthally averaged measures of hurricane strength by several researchers Unfortunately, the use of these instruments (e.g. the Microwave Sounding Units, MSU) for the routine monitoring of tropical cyclone genesis and intensity has been hampered by poor resolution. The recent launch of the NOAA-15 AMSU represents a significant advance in our ability to monitor subtle atmospheric temperature

variations (0.1-0.2 C) at relatively high spatial resolution (50 km) in the presence of clouds. of particular interest is the possible capability of the AMSU to observe the slight warming associated with depression formation, and the relationship of the spatial characteristics of the warming to the surface pressure and wind field, without azimuthal averaging. In order to present the AMSU data as imagery, we have developed a method for precise limb-correction of all 15 AMSU channels. Through a linear combination of several neighboring channels, we can very closely match the nadir weighting functions of a given AMSU sounding channel with the non-nadir data. It is found that there is discernible, localized upper tropospheric warming associated with depression formation in the Atlantic basin during the 1998 hurricane season. Also, it is found that uncertainty in positioning of tropical cyclone circulation centers can be reduced, as in the example of Hurricane Georges as it approached Cuba. Finally, to explore the potential utility of a future high resolution microwave temperature sounder, we present an analysis of the relationship between the modeled surface wind field and simulated high -resolution AMSU-type measurements, based upon cloud resolving model simulations of hurricane Andrew in 1992.
Author
Atmospheric Models; Troposphere; Microwave Radiometers; Hurricanes; Imagery; Temperature Profiles; Tropical Storms; Velocity Distribution; Heating

19990040839 World Meteorological Organization, World Climate Data and Monitoring Programme, Geneva, Switzerland
Statistical Methods ***Progress Report***
Schoenwiese, Christian-Dietrich, Johann-Wolfgang-Goethe-Univ., Germany; Progress Reports to CCl on Statistical Methods; Jul. 1997; 124p; In English; See also 19990040840 through 19990040841
Report No.(s): WCDMP-32; WMO-TD-834; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche
Contents include the following: statistical analysis of observed climate trends and statistical signal detection analysis and climate trend atlas fo Europe based on observation 1891-1990.
CASI
Statistical Analysis; Climate

19990040840 World Meteorological Organization, World Climate Data and Monitoring Programme, Geneva, Switzerland
Statistical Analysis of Observed Climate Trends and Statistical Signal Detection Analysis ***Annual Report***
Schoenwiese, Christian-Dietrich, Johann-Wolfgang-Goethe-Univ., Germany; Statistical Methods; Jul. 1997, pp. 1-19; In English; See also 19990040839; No Copyright; Avail: CASI; A03, Hardcopy; A02, Microfiche
This is first brief Annual Progress Report to CCI on statistical methods in climatology concerning: (1) the statistical analysis of observed climate trends and (2) the statistical detection of climate signals due to particular forcing mechanisms. It refer to the year 1995 where two highlights should be predominantly considered. It may be useful to outline first the definitions of the terms 'trend' and 'signal'. Given any climate time series, e. g. the annual global mean surface air temperatures assessed from observations 1854 - 1995 (IPCC, 1996-. Jones, 1996), three components of variations can be discerned: (1) high-frequent variability, in this case the year-to-year variations of the temperature anomalies as observed, (2) relatively low-frequent variability, in this case identified by means of a 10 yr Gaussian low-pass filter (or any other corresponding filter technique, conventional, see WMO, 1966), and (3) ultra-low-frequent variability which may be identified by means of a linear or non-linear trend.
Derived from text
Statistical Analysis; Climatology; Time Series Analysis; Atmospheric Temperature

19990040841 World Meteorological Organization, World Climate Data and Monitoring Programme, Geneva, Switzerland
Climate Trend Atlas of Europe Based on Observations 1891 - 1990
Schoenwiese, Christian-Dietrich, Johann-Wolfgang-Goethe-Univ., Germany; Rapp, Joerg, Johann-Wolfgang-Goethe-Univ., Germany; Statistical Methods; Jul. 1997, pp. 21-115; In English; See also 19990040839; No Copyright; Avail: CASI; A05, Hardcopy; A02, Microfiche
Climate varies on all scales of time and space by a large variety of reasons. However, before any discussion of reasons can be performed it is necessary to realize the very facts of climate variability by means of observations or reconstructions, respectively. In this book we focus on observed long-term trends of selected climate elements (temperature, precipitation, humidity, pressure) as revealed by direct measurements of the European station network within the recent 100 years. of course, there are a number of problems in detail: reliability and accuracy of data, time series homogeneity, statistical confidence of trends and so on. We hope that these problems are addressed in an instructive and, as far as possible, exhausting way. The main purpose of this work, however, was to provide a collection of trend charts which specify the regional particularities of observed climate trends in different months

or seasons of the year leading us to an 'Atlas of observed climate trends in Europe'. Keeping in mind the recent World Meteorological Organization (WMO) climate normal (CLINO) period, we have also calculated the 1961-1990 trends.
Derived from text
Climate; Variability; Trends; Time Series Analysis; Reliability; Charts; Accuracy

19990040885 Instituto Nacional de Pesquisas Espacias, Sao Jose dos Campos, Brazil
Performance of Simple and Derived Variable Forecasts Obtained by the CPTEC/COLA Global Model for Some Significant Cases Occurred over South-Central Brazil ***Desempenho das Previsoes de Variaveis Simples e Derivadas Obtidas Pelo Modelo Global do CPTEC/COLA para Alguns Casos Significativos Ocorridos Sobre o Centro-Sul do Brasil***
Bitencounrt, Daniel Pires, Instituto Nacional de Pesquisas Espacias, Brazil; Dec. 1996; 140p; In Portuguese
Report No.(s): INPE-6407-TDI/617; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

The Center for Weather Prediction and Climate Studies (CPTEC), inaugurated in November 1994, is running operationally a global Numerical Weather Prediction (NWP) model known as CPTEC/COLA. to obtain increased reliability of weather forecasts it is necessary to constantly improve the model, and to achieve this, it is necessary to estimate the prediction skill of the model and to study the magnitude and nature of systematic and sporadic errors in the forecasts. Traditionally the performance statistics of the NWP models are calculated by quantitatively comparing the forecast fields and the corresponding analysis fields of simple model variables such as geopotential height at 500 hPa, wind components at 850 and 200 hPa. In the present study the statistics to test the performance of the model are obtained also with important derived variables, namely, divergence, vorticity, thickness, thermal advection, vorticity advection, water vapor convergence and Q-vector. It is demonstrated, through simple mathematical analysis, that, the "anomaly correlation" of a derived variable (such as thermal gradient) is different from that of a simple variable (such as temperature) when the field is composed of more than one wave number. The shorter wave number performance has a larger weight in the anomaly correlation of the composed field of the derived variable. The performance of CPTEC/COLA is tested in four case studies over the South American region. In general, the spatial variability and the root mean square error of the forecast fields increase and the anomaly correlation decreases with the forecast range for all the variables. The derived fields have worse performance statistics than the simple variables. The first case shows the essential differences in the predictability in the extratropics and in the tropics of the region. The other cases provide an idea of the reliability of each of the meteorological variables used for estimating the model performance, and indicate the variables having best predictability for each situation.
Author
Performance Prediction; Forecasting; Global Positioning System; Atmospheric Models; Climate; Meteorological Parameters; Numerical Weather Forecasting; Weather Forecasting

19990041049 NASA Goddard Inst. for Space Studies, New York, NY USA
Comparison of the Seasonal Change in Cloud-Radiative Forcing from Atmospheric General Circulation Models and Satellite Observations
Cess, R. D., State Univ. of New York, USA; Zhang, M. H., State Univ. of New York, USA; Potter, G. L., Lawrence Livermore National Lab., USA; Alekseev, V., Academy of Sciences (USSR), USSR; Barker, H. W., Canadian Climate Centre, Canada; Bony, S., Laboratoire de Meteorologie Dynamique, France; Colman, R. A., Bureau of Meteorology, Australia; Dazlich, D. A., Colorado State Univ., USA; DelGenio, A. D., NASA Goddard Inst. for Space Studies, USA; Deque, M., Centre National de Recherches Meteorologiques, France; Dix, M. R., Commonwealth Scientific and Industrial Research Organization, Australia; Dymnikov, V., Academy of Sciences (USSR), USSR; Esch, M., Max-Planck-Inst. fuer Meteorologie, Germany; Fowler, L. D., Colorado State Univ., USA; Fraser, J. R., Bureau of Meteorology, Australia; Galin, V., Academy of Sciences (USSR), USSR; Gates, W. L., Lawrence Livermore National Lab., USA; Hack, J. J., National Center for Atmospheric Research, USA; Ingram, W. J., Meteorological Office, UK; Kiehl, J. T., National Center for Atmospheric Research, USA; Journal of Geophysical Research; Jul. 27, 1997; ISSN 0148-0227; Volume 102, No. D14, pp. 16,593-16,603; In English; Sponsored in part by Programme National d'Etude de la Dynamique du Climat and U.S.-Russian Working Group 8 Activity
Report No.(s): Paper-97JD00927; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

We compare seasonal changes in cloud-radiative forcing (CRF) at the top of the atmosphere from 18 atmospheric general circulation models, and observations from the Earth Radiation Budget Experiment (ERBE). to enhance the CRF signal and suppress interannual variability, we consider only zonal mean quantities for which the extreme months (January and July), as well as the northern and southern hemispheres, have been differenced. Since seasonal variations of the shortwave component of CRF are caused by seasonal changes in both cloudiness and solar irradiance, the latter was removed. In the ERBE data, seasonal changes in CRF are driven primarily by changes in cloud amount. The same conclusion applies to the models. The shortwave component

of seasonal CRF is a measure of changes in cloud amount at all altitudes, while the longwave component is more a measure of upper level clouds. Thus important insights into seasonal cloud amount variations of the models have been obtained by comparing both components, as generated by the models, with the satellite data. For example, in 10 of the 18 models the seasonal oscillations of zonal cloud patterns extend too far poleward by one latitudinal grid.
Author
Cloud Cover; Atmospheric General Circulation Models; Earth Radiation Budget Experiment; Models; Research

19990041054 NASA Ames Research Center, Moffett Field, CA USA
Cirrus Cloud Radiative and Microphysical Properties from Ground Observations and In Situ Measurements During FIRE 1991 and Their Application to Exhibit Problems in Cirrus Solar Radiative Transfer Modeling
Kinne, Stefan, NASA Ames Research Center, USA; Akerman, T. P., Pennsylvania State Univ., USA; Shiobara, M., Meteorological Research Inst., Japan; Uchiyama, A., Meteorological Research Inst., Japan; Heymsfield, A. J., National Center for Atmospheric Research, USA; Miloshevich, L., National Center for Atmospheric Research, USA; Wendell, J., National Oceanic and Atmospheric Administration, USA; Eloranta, E. W., Wisconsin Univ., USA; Purgold, C., NASA Langley Research Center, USA; Bergstrom, R. W., Bay Area Environmental Research Inst., USA; Journal of the Atmospheric Sciences; 1997; Volume 54, pp. 2320-2344; In English
Contract(s)/Grant(s): NCC2-940; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

Measurements from the FIRE 1991 cirrus cloud field experiment in the central USA are presented and analyzed. The first part focuses on cirrus microphysical properties. Aircraft 2D-probe in situ data at different cloud altitudes were evaluated for cirrus cases on four different days. Also presented are simultaneous data samples from balloonborne videosondes. Only these balloonsondes could detect the smaller crystals. Their data suggest (at least for midlatitude altitudes below 10 km) that ice crystals smaller than 15 microns in size are rare and that small ice crystals not detected by 2D-probe measurements are radiatively of minor importance, as overlooked 2D-probe crystals account for about 10% of the total extinction. The second part focuses on the link between cirrus cloud properties and radiation. With cloud macrophysical properties from surface remote sensing added to the microphysical data and additional radiation measurements at the surface, testbeds for radiative transfer models were created. to focus on scattering processes, model evaluations were limited to the solar radiative transfer by comparing calculated and measured transmissions of sunlight at the surface. Comparisons under cloud-free conditions already reveal a model bias of about +45 W/sq m for the hemispheric solar downward broadband flux. This discrepancy, which is (at least in part) difficult to explain, has to be accounted for in comparisons involving clouds. Comparisons under cirrus cloud conditions identify as the major obstacle in cirrus solar radiative transfer modeling the inability of one-dimensional radiative transfer models to account for horizontal inhomogeneities. The successful incorporation of multidimensional radiative transfer effects will depend not only on better models but critically on the ability to measure and to define characteristic inhomogeneity scales of cloud fields. The relative minor error related to the microphysical treatment is in part a reflection of the improved understanding on solar scattering on ice crystals over the last decade and of the available wealth on ice-crystal size and shape data for this study. In absence of this information, uncertainties from microphysical cirrus model assumptions will remain high.
Author
Cloud Physics; Cirrus Clouds; Radiative Transfer; Solar Flux; Data Processing; Remote Sensing

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OCEANOGRAPHY

Includes biological, dynamic, and physical oceanography; and marine resources. For related information see also 43 Earth Resources and Remote Sensing.

19990040428 Oceanography Society, Virginia Beach, VA USA
Oceanography - High Frequency Radar and Ocean Thin Layers, Volume 10 ***Final Report, 15 Jun. 1997 - 31 Dec. 1998***
Atkinson, Larry P.; Mar. 11, 1999; 77p; In English
Contract(s)/Grant(s): N00014-97-1-0851
Report No.(s): AD-A361115; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

Partial contents include: (1) HF Radar Instruments, Past to Present; (2) Mapping Surface Currents in Monterey Bay with

CODAR-type HF Radar; (3) The Coastal Jet: Observations of Surface Currents over the Oregon Continental Shelf from HF Radar; (4) Tidal and Wind-driven Currents from OSCR; (5) Larval Transport and Coastal Upwelling: an Application of HF Radar in Ecological Research; (6) Evolution of Bearing Determination in HF Current Mapping Radars; (7) Shipboard Deployment of a VHF OSCR System for Measuring Offshore Currents; and (8) Experience with Shipborne Measurements of Surface Current Fields by Radar.
DTIC
Oceanography; High Frequencies; Ocean Surface; Radar Maps

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LIFE SCIENCES (GENERAL)

19990038350 National Academy of Sciences - National Research Council, Washington, DC USA
Institute of Laboratory Animal Research (ILAR) ***Annual Report, 1 Apr. 1998 - 31 Mar. 1999***
Dell, Ralph; Mar. 1999; 13p; In English
Contract(s)/Grant(s): DAMD17-98-1-8275
Report No.(s): AD-A361548; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The Institute for Laboratory Animal Research (ILAR) is a component of the Commission on Life sciences (CLS), National Research Council (NRC). Partial support for ILAR has been provided for many years from the Department of the Army to enable ILAR to fulfill its mission. Founded in 1952, ILAR has become recognized nationally and internationally as a leader in developing and making available to the biomedical and laboratory animal science communities guidelines for animal care, breeding, and use; descriptions of animal models for human diseases and physiological processes; and reports on specific issues of humane care and use of laboratory animals. ILAR's mission is to help improve the availability, quality, care, and humane and scientifically valid use of laboratory animals. ILAR accomplishes its goals through its core program, which is carried out by the staff and its special-project program, which is carried out by NRC-appointed committees with staff assistance. The number of committees and size of the staff are dependent on the number of special projects and available funding. Both programs are directed by a 14-member Council comprised of experts in laboratory animal medicine, zoology, genetics, medicine, ethics, and related biomedical sciences. The Army funds partially support general office operations, the Animal Models and Genetic Stocks Information Program, publication of ILAR Journal, and work of the Council.
DTIC
Life Sciences; Animals; Breeding (Reproduction); Diseases; Medical Science; Information Theory; Laboratories

19990040270 Pennsylvania Univ., Center for Bioactive Materials and Tissue Engineering, Philadelphia, PA USA
Reactions and Surface Transformations of a Bone-Bioactive Material in a Simulated Microgravity Environment
Radin, S., Pennsylvania Univ., USA; Ducheyne, P., Pennsylvania Univ., USA; Ayyaswamy, P. S., Pennsylvania Univ., USA; NASA Microgravity Materials Science Conference; February 1999, pp. 163-167; In English; See also 19990040241
Contract(s)/Grant(s): NAG8-1483; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

A comprehensive program to investigate the expeditious in vitro formation of three-dimensional bone-like tissue is currently underway at the University of Pennsylvania. The study reported here forms a part of that program. Three-dimensional bone-like tissue structures may be grown under the simulated microgravity conditions of NASA designed Rotating Wall Bioreactor Vessels (RWV's). Such tissue growth will have wide clinical applications. In addition, an understanding of the fundamental changes that occur to bone cells under simulated microgravity would yield important information that will help in preventing or minimizing astronaut bone loss, a major health issue with travel or stay in space over long periods of time. The growth of three-dimensional bone-like tissue structures in RWV's is facilitated by the use of microcarriers which provide structural support. If the microcarrier material additionally promotes bone cell growth, then it is particularly advantageous to employ such microcarriers. We have found that reactive, bone-bioactive glass (BBG) is an attractive candidate for use as microcarrier material. Specifically, it has been found that BBG containing Ca- and P- oxides upregulates osteoprogenitor cells to osteoblasts. This effect on cells is preceded by BBG reactions in solution which result in the formation of a Ca-P surface layer. This surface further transforms to a bone-like mineral (i.e., carbonated crystalline hydroxyapatite (c-HA)). At normal gravity, time-dependent, immersion-induced BBG reactions and transformations are greatly affected both by variations in the composition of the milieu in which the glass is immersed and on the immersion conditions. However, the nature of BBG reactions and phase transformations under the simulated microgravity conditions of RWV's are unknown, and must be understood in order to success-

fully use BBG as microcarrier material in RWV'S. In this paper, we report some of our recent findings in this regard using experimental and numerical methods. BBG composition 45S5, the most reactive among known bone-bioactive glasses, was chosen for the study. BBG 45S5 behavior in physiological solutions was tested in simulated microgravity and compared with that at normal gravity. On the basis of our numerical study, we have chosen the BBG granule size to be in the range 40-70 microns, and a RWV rotational speed of 10 rpm. Our numerical study has shown that these parameters enable the microcarrier to remain suspended in the medium without experiencing collisions with the wall of the vessel. Immersion-induced changes in the solution composition and the material surface were analyzed after immersion.
Derived from text
Microgravity; Gravitational Effects; Space Environment Simulation; Tissues (Biology); Bones; Cells (Biology); Phase Transformations

19990040425 Search for Extraterrestrial Intelligence Inst., Moffett Field, CA USA
Energy from Redox Disproportionation of Sugar Carbon Drives Biotic and Abiotic Synthesis
Weber, Arthur L., Search for Extraterrestrial Intelligence Inst., USA; Journal of Molecular Evolution; 1997; Volume 44, pp. 354-360; In English; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

To identify the energy source that drives the biosynthesis of amino acids, lipids, and nucleotides from glucose, we calculated the free energy change due to redox disproportionation of the substrate carbon of: (1) 26-carbon fermentation reactions and (2) the biosynthesis of amino acids and lipids of E. coli from glucose. The free energy (cal/mmol of carbon) of these reactions was plotted as a function of the degree of redox disproportionation of carbon (disproportionative electron transfers (mmol)/mmol of carbon). The zero intercept and proportionality between energy yield and degree of redox disproportionation exhibited by this plot demonstrate that redox disproportionation is the principal energy source of these redox reactions (slope of linear fit = -10.4 cal/mmol of disproportionative electron transfers). The energy and disproportionation values of E. coli amino acid and lipid biosynthesis from glucose lie near this linear curve fit with redox disproportionation accounting for 84% and 96% (and ATP only 6% and 1%) of the total energy of amino acid and lipid biosynthesis, respectively. These observations establish that redox disproportionation of carbon, and not ATP, is the primary energy source driving amino acid and lipid biosynthesis from glucose. In contrast, we found that nucleotide biosynthesis involves very little redox disproportionation, and consequently depends almost entirely on ATP for energy. The function of sugar redox disproportionation as the major source of free energy for the biosynthesis of amino acids and lipids suggests that sugar disproportionation played a central role in the origin of metabolism, and probably the origin of life.
Author
Oxidation-Reduction Reactions; Synthesis (Chemistry); Biosynthesis; Sugars; Glucose; Free Energy; Amino Acids; Adenosine Triphosphate

19990040822 Columbia Univ., Coll. of Physicians and Surgeons, New York, NY USA
Development of the Fish Medaka in Microgravity ***Final Report***
Wolgemuth, Debra J., Columbia Univ., USA; [1995]; 14p; In English
Contract(s)/Grant(s): NAG2-987; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The goal of these experiments was to determine the effect of microgravity on the early development of the fish medaka. There were two objectives for this flight series. The primary objective was to assess the effects of microgravity on different stages of development and to ascertain whether the relevant developmental questions can be addressed at the gross morphological level or if the issues involve more subtle questions about regulation at the molecular and cellular levels. The secondary objective was the assessment of the utility of flight hardware with the capabilities to perform embryological studies. We have been able to take advantage of the flight testing phase of the STL-B hardware to also study the effects of microgravity on the early development of the fish, Medaka. Our initial studies involved monitoring the early Medaka development and raising flight embryos for breeding. Images of the developing embryos were collected either via video which was either taken by the astronauts or broadcast to Earth. Sample video images were digitized and stored on a hard drive resident within the on-board STL-B unit. Embryos were fixed at specific intervals, returned to Earth and are being analyzed for the timing and location of molecular events associated with controlling the morphological pattern for the onset of adult structures.
Author
Breeding (Reproduction); Fishes; Microgravity; Spaceborne Experiments

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AEROSPACE MEDICINE

Includes physiological factors; biological effects of radiation; and effects of weightlessness on man and animals.

19990038349 Louisiana State Univ., Pennington Biomedical Research Center, Baton Rouge, LA USA
Determination of Total Daily Energy Requirements and Activity Patterns of Service Women ***Annual Report, 26 Sep. 1997 - 25 Sep. 1998***
Delany, James P.; Oct. 1998; 28p; In English
Contract(s)/Grant(s): DAMD17-96-2-6025
Report No.(s): AD-A361586; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The objective of the current study is to define a range of energy requirements of service women, defining the variation as it relates to jobs, military settings, and activity patterns. This is crucial information needed not only for determination of nutritional requirements for energy balance, but specific nutrient density standards for servicewomen. Total daily energy expenditure is measured using the doubly labeled water (DLW) method. Activity patterns from actigraphs will be analyzed for hours of sleep, description of job/work patterns by examining bursts of concerted activity versus steady activity. Men will also be studied in these settings. Energy requirements' for men have been better established and will serve to anchor the results obtained in women to previously established norms in men. Several field studies will be conducted over the course of the grant. The first field study was conducted at Fort Bragg/Camp Mckall during a Combat Support Hospital training exercise. Energy expenditures were moderate, and higher in men than women. However, when adjusting for differences in body size, energy expenditures were similar.
DTIC
Nutrition; Balance; Nutritional Requirements; Physical Exercise; Energy Budgets; Fatigue (Biology); Human Tolerances

19990040418 Aerospace Corp., Technology Operations, El Segundo, CA USA
A Survey of the Potential Effects of Increasing UV-B Radiation on the Biosphere. Revision
Martin, L. R.; Sep. 30, 1998; 38p; In English
Contract(s)/Grant(s): F04701-93-C-0094
Report No.(s): AD-A361283; TR-98(1306)-6; SMC-TR-99-08; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

There are by now well-established connections between the introduction of chlorine-containing molecules into the stratosphere, a consequent decrease in the concentration of stratospheric ozone, and an increase in UV-B radiation at the surface of the Earth. An increase in UV-B on average would increase the incidence rate of non-melanoma skin cancer worldwide, with an unproved but likely increase in melanoma skin cancer. Other effects on humans could include cataracts and immune system inhibition, but these are less well established. The response of domestic and wild animal populations to UV-B is not thought to be a serious problem at this time, in part because they are protected by fur. The response of plants is complex because plants exist in a highly competitive situation with other plants for water and light, and must survive in an environment of pests and diseases, which may also be affected by UV-B. The oceanic phytoplankton are the basis of the ocean food chain and are responsible for half of the natural carbon dioxide fixation. Studies have indicated that the phytoplankton are adversely affected by UV-B, and thus there is a potential for excess UV-B to affect fishing yields and the amount of carbon dioxide in the atmosphere.
DTIC
Cancer; Ozone Depletion; Ultraviolet Radiation; Atmospheric Composition; Ozone

19990040686 NASA Langley Research Center, Hampton,VA USA
Aerospace Medicine and Biology: A Continuing Bibliography With Indexes, Supplement 491
May 17, 1999; 22p; In English
Report No.(s): NASA/SP-1999-7011/SUPPL491; NAS 1.21:7011/SUPPL491; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report lists reports, articles and other documents recently announced in the NASA STI Database.
Author
Aerospace Medicine; Bibliographies

19990040936 Aeromedical Inst., Soesterberg, Netherlands
Degenerative Changes of the Spine in Pilots of the RNLAF ***Final Report Degeneratieve Veranderingen in de Wervelkolom bij F-16 Vliegers***
Hendriksen, I. J. M., Aeromedical Inst., Netherlands; Holewijn, M., Aeromedical Inst., Netherlands; Mar. 1998; 32p; In English
Contract(s)/Grant(s): A96/KLu/02

Report No.(s): Rept-1998-K2; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The aim of this study was to examine whether F-16 pilots are at an increased risk of(cervical) spine degeneration. Retrospectively, all pilots of the Royal Netherlands Air Force (RNLAF) that were systematically radiographed (at least twice) in the period between 1982 and I994, were examined. In total 316 pilots were evaluated, 188 F-16 pilots (mean age 28.5 years at initial x-ray) and 128 pilots in the Control group (mean age 24.2 years at initial x-ray). The Control group consisted of 64 helicopter pilots, 63 NF-5 pilots and 1 F-27 Pilot. None of this group of pilots had more than 150 hours flying experience with an F-16. Two radiologists, who were blinded as to whether the x-ray films were of F-16 pilots or Control group, examined these x-rays separately. In both groups, the time between the two x-rays was on average 6 years. In these years the Control group had a significantly higher mean number of flying hours compared to the F-16 group (resp. 922 versus 690 hrs). Though the inter-rater agreement of the x-rays was rather low, both radiologists found comparable statistical significant differences between the two groups, on several levels of the cervical spine. In the F-16 group, an increased osteophytic spurring was found at levels C4-C5 and C6-C7,and increased arthrosis deformans was found in the cervical spine. Further analysis ofthe data of a selection ofthe total group of pilots, whereby the difference in age between both groups was minimized, showed that the higher mean age ofthe F-16 pilots was possibly correlated with the increased degeneration in this group. No consistent relationship was found between spinal degeneration and initial radiological status. Also, it appeared that increasing levels of spinal degeneration were not related to increasing flight hours. These findings suggest that frequent exposure to high + G(sub z) forces might cause premature degeneration of the spine in F-16 pilots. Future research has to demonstrate to what extent age, mission, and number of flying hours have influenced the results. An uniform international classification and coding system in combination with establishing an international data-base is recommended in order to more fully understand the relationship between exposure to high + G(sub z) forces and spinal degeneration.
Author

Data Bases; Degeneration; Exposure; Radiology; Spine; X Rays; Pilots (Personnel); Research

19990040967 Bionetics Corp., Cocoa Beach, FL USA

Proceedings from the 1998 Occupational Health Conference: Benchmarking for Excellence

Hoffler, G. Wyckliffe, Editor, Bionetics Corp., USA; O'Donnell, Michele D., Editor, Bionetics Corp., USA; Proceedings from the 1998 Occupational Health Conference: Benchmarking for Excellence; February 1999; 254p; In English; 2nd; Benchmarking For Excellence, 24-28 Aug. 1998, Orlando, FL, USA; Sponsored by NASA Kennedy Space Center, USA; See also 19990040968 through 19990041018

Contract(s)/Grant(s): NAS10-12180; S-NAS10-001; RTOP 004-Y3

Report No.(s): NASA/CP-1999-208543; NAS 1.55:208543; No Copyright; Avail: CASI; A12, Hardcopy; A03, Microfiche

The theme of the 1998 NASA Occupational Health Conference was "Benchmarking for Excellence." Conference participants included NASA and contractor Occupational Health professionals, as well as speakers from NASA, other Federal agencies and private companies. Addressing the Conference theme, speakers described new concepts and techniques for corporate benchmarking. They also identified practices used by NASA, other Federal agencies, and by award winning programs in private industry. A two-part Professional Development Course on workplace toxicology and indoor air quality was conducted a day before the Conference. A program manager with the International Space Station Office provided an update on station activities and an expert delivered practical advice on both oral and written communications. A keynote address on the medical aspects of space walking by a retired NASA astronaut highlighted the Conference. Discipline breakout sessions, poster presentations, and a KSC tour complemented the Conference agenda.
Author

Conferences; Health; Standardization; Safety Management; Personnel Management; Quality Control

19990040968 Blair and Burke, College Station, TX USA

Benchmarking: Workplace Trends and Current Issues in Occupational Health

Blair, Brenda R., Blair and Burke, USA; Proceedings from the 1998 Occupational Health Conference: Benchmarking for Excellence; February 1999, pp. 4-17; In English; See also 19990040967; No Copyright; Avail: CASI; A03, Hardcopy; A03, Microfiche

Occupational health services, like similar employer-provided services in the workplace, must assist in improving employee health and well being while at the same time enhancing productivity. This dual mission requires that Occupational Health Departments adopt continuous quality improvement systems just like any other function within the organization. It thus requires internal analysis, periodic benchmarking against other organizations, and constant monitoring of trends in the larger society which affect the delivery of occupational health services. The purpose of this paper is fourfold: (1) to present an overview of benchmarking, including definitions, objectives and methods; (2) to discuss trends in the workplace which affect the delivery of occupational

health services; (3) to identify trends in healthcare delivery in the US which affect the delivery of occupational health services; and (4) to identify and discuss trends in occupational health care in the US today.
Derived from text
Medical Services; Public Health; Standards; Quality Control

19990040969 NASA Kennedy Space Center, Cocoa Beach, FL USA
Results Oriented Benchmarking: The Evolution of Benchmarking at NASA from Competitive Comparisons to World Class Space Partnerships
Bell, Michael A., NASA Kennedy Space Center, USA; Proceedings from the 1998 Occupational Health Conference: Benchmarking for Excellence; February 1999, pp. 20-23; In English; See also 19990040967; No Copyright; Avail: CASI; A01, Hardcopy; A03, Microfiche

Informal benchmarking using personal or professional networks has taken place for many years at the Kennedy Space Center (KSC). The National Aeronautics and Space Administration (NASA) recognized early on, the need to formalize the benchmarking process for better utilization of resources and improved benchmarking performance. The need to compete in a faster, better, cheaper environment has been the catalyst for formalizing these efforts. A pioneering benchmarking consortium was chartered at KSC in January 1994. The consortium known as the Kennedy Benchmarking Clearinghouse (KBC), is a collaborative effort of NASA and all major KSC contractors. The charter of this consortium is to facilitate effective benchmarking, and leverage the resulting quality improvements across KSC. The KBC acts as a resource with experienced facilitators and a proven process. One of the initial actions of the KBC was to develop a holistic methodology for Center-wide benchmarking. This approach to Benchmarking integrates the best features of proven benchmarking models (i.e., Camp, Spendolini, Watson, and Balm). This cost-effective alternative to conventional Benchmarking approaches has provided a foundation for consistent benchmarking at KSC through the development of common terminology, tools, and techniques. Through these efforts a foundation and infrastructure has been built which allows short duration benchmarking studies yielding results gleaned from world class partners that can be readily implemented. The KBC has been recognized with the Silver Medal Award (in the applied research category) from the International Benchmarking Clearinghouse.
Derived from text
Standardization; NASA Programs; Cost Effectiveness; Quality Control; Specifications

19990040970 Bionetics Corp., Occupational Health Program Support Office, Cocoa Beach, FL USA
Benchmarking the Federal Agencies
Ferguson, Emmett B., Jr., Bionetics Corp., USA; Proceedings from the 1998 Occupational Health Conference: Benchmarking for Excellence; February 1999, pp. 24-30; In English; See also 19990040967; No Copyright; Avail: CASI; A02, Hardcopy; A03, Microfiche

The theme of benchmarking for this year's annual conference was selected almost one year ago. A group of excellent speakers was identified to discuss the process of benchmarking and describe some of the outstanding examples in corporate occupational health. The possibility was recognized that there might be excellent examples of occupational health services in the Federal sector. A meeting to discuss benchmarking Occupational Health Services in the Federal agencies was held early this year. Based on these discussions, a study was funded to identify the best practices and innovative approaches within other Federal agencies that provide employee health services. The study is intended to scope the investment in occupational health services in the Federal government and to recommend a benchmarking approach that can be used by the NASA centers as an ongoing program evaluation tool.
Derived from text
Health; Medical Services; Standardization; Organizations

19990040971 American Airlines, Inc., AMR Corp., Fort Worth, TX USA
Technological Advances in Travel Medicine
McKenas, David K., American Airlines, Inc., USA; Proceedings from the 1998 Occupational Health Conference: Benchmarking for Excellence; February 1999, pp. 31-39; In English; See also 19990040967; No Copyright; Avail: CASI; A02, Hardcopy; A03, Microfiche

It has been said that 100,000 people, the population of a moderate-sized city, travel in the skies over the domestic USA at any moment. Unlike a city, however, not much in the way of on-board emergency medical systems are available to them-that is, until recently. Many factors went into American's decision to greatly enhance on-board medical equipment on its fleet, and this paper will present that rationale. All major air carriers are following American's lead in these programs, and as a result, many

customer lives will be saved, and on-board passenger medical morbidity due to on-board illnesses and emergencies will be reduced.
Derived from text
Medical Equipment; Medical Services; Emergency Life Sustaining Systems; Technology Assessment; Airline Operations

19990040972 International SOS Assistance, Inc., International Healthcare Div., Indonesia
International Travel Health Considerations
Weston, Robert L., International SOS Assistance, Inc., Indonesia; Proceedings from the 1998 Occupational Health Conference: Benchmarking for Excellence; February 1999, pp. 40-43; In English; See also 19990040967; No Copyright; Avail: CASI; A01, Hardcopy; A03, Microfiche

The paper summarizes the development and evolution of the travel medicine specialty (Emporiatrics). The major travel medicine problems (diarrhea, accident, illness, malaria), evolution of entry requirements, eradication programs, emergence and reemergence of infectious disease, special risks, preventive measures, political and environmental risks, stress of overseas duties, and the need for reliable resources and assistance are reviewed.
Derived from text
Public Health; Travel; Sicknesses; Diseases; Medical Services

19990040975 Postal Service, Risk Management, Washington, DC USA
U.S. Postal Service Safety and Risk Management Overview
Jones, Jerry A., Postal Service, USA; Proceedings from the 1998 Occupational Health Conference: Benchmarking for Excellence; February 1999, pp. 54-56; In English; See also 19990040967; No Copyright; Avail: CASI; A01, Hardcopy; A03, Microfiche

The Benchmarking study of Ferguson provided a large amount of information from other government agencies. Perhaps the most impressive and useful with regard to implementation of well-conceived programs was by the U. S. Postal Services. The manager of Risk Management for the U.S. Postal Services describes the health and safety services implemented for the 890,000 employees in more than 38,000 locations in the Postal Service and illustrates the magnitude of the undertaking. The salient features of the program are outlined and material that address programs, strategies and assessment of outcomes is presented.
Derived from text
Risk; Standardization; Safety Management

19990040976 MEDSTAT Group, Washington, DC USA
Developing Normative and Benchmark Data For Health and Productivity Management: Results of a Multi-Employer Benchmarking Study
Goetzel, Ron Z., MEDSTAT Group, USA; Proceedings from the 1998 Occupational Health Conference: Benchmarking for Excellence; February 1999, pp. 57-64; In English; See also 19990040967; No Copyright; Avail: CASI; A02, Hardcopy; A03, Microfiche

The following topics are discussed in the paper: (1) Developing a Model for Health and Productivity Management (HPM); (2) Results of the American Productivity and Quality Council (APQC)/MEDSTAT HPM Consortium Benchmarking Study; (3) Case Studies of Best Practice Organizations; and (4) Implications and Future Directions.
Derived from text
Health; Productivity; Standardization; Management Methods

19990040977 Johnson and Johnson, Inc., New Brunswick, NJ USA
Johnson & Johnson Benchmarking for Excellence Corporate Health Achievement Award Winner
Lemons, Susan L., Johnson and Johnson, Inc., USA; Isaac, Fikry W., Johnson and Johnson, Inc., USA; Proceedings from the 1998 Occupational Health Conference: Benchmarking for Excellence; February 1999, pp. 67-72; In English; See also 19990040967; No Copyright; Avail: CASI; A02, Hardcopy; A03, Microfiche

The Signature of Quality Program, the name given to the continuous improvement and Total Quality Management at Johnson & Johnson, is presented. The company's background as a diversified health care company is described. The credo of Johnson & Johnson, their definition of Benchmarking, three types of Benchmarking, process management, their code of conduct, and what is being offered in the market place is also presented.
Derived from text
Health; Total Quality Management; Standardization; Industrial Management

19990040978 Johnson and Johnson, Inc., New Brunswick, NJ USA

An Integrated Shared Services Model

Isaac, Fikry W., Johnson and Johnson, Inc., USA; Proceedings from the 1998 Occupational Health Conference: Benchmarking for Excellence; February 1999, pp. 73-80; In English; See also 19990040967; No Copyright; Avail: CASI; A02, Hardcopy; A03, Microfiche

Johnson & Johnson embarked on a study of their Health and Wellness services to benchmark similar programs and develop an improvement plan. The effort resulted in actions to integrate a number of related support services throughout the Corporation. The comprehensive employee health services, employee assistance programs and wellness programs were targeted for the reorganization. The resulting organization provides unified leadership standardized procedures including accountability, and cost assessments. Prevention and education were priorities in the new organization, but direct input into employee health benefits was an important part of the integrated services. The report describes the extensive service delivery model and provides details of the successful implementation of the integrated services plan.

Derived from text

Medical Services; Health; Models; Support Systems

19990040982 NASA Kennedy Space Center, Cocoa Beach, FL USA

NASA Occupational Health Program FY98 Self-Assessment

Brisbin, Steven G., NASA Kennedy Space Center, USA; Proceedings from the 1998 Occupational Health Conference: Benchmarking for Excellence; February 1999, pp. 96-97; In English; See also 19990040967; No Copyright; Avail: CASI; A01, Hardcopy; A03, Microfiche; Abstract Only; Abstract Only

The NASA Functional Management Review process requires that each NASA Center conduct self-assessments of each functional area. Self-Assessments were completed in June 1998 and results were presented during this conference session. During FY 97 NASA Occupational Health Assessment Team activities, a decision was made to refine the NASA Self-Assessment Process. NASA Centers were involved in the ISO registration process at that time and wanted to use the management systems approach to evaluate their occupational health programs. This approach appeared to be more consistent with NASA's management philosophy and would likely confer status needed by Senior Agency Management for the program. During FY 98 the Agency Occupational Health Program Office developed a revised self-assessment methodology based on the Occupational Health and Safety Management System developed by the American Industrial Hygiene Association. This process was distributed to NASA Centers in March 1998 and completed in June 1998. The Center Self Assessment data will provide an essential baseline on the status of OHP management processes at NASA Centers. That baseline will be presented to Enterprise Associate Administrators and DASHO on September 22, 1998 and used as a basis for discussion during FY 99 visits to NASA Centers. The process surfaced several key management system elements warranting further support from the Lead Center. Input and feedback from NASA Centers will be essential to defining and refining future self assessment efforts.

Derived from text

Industrial Safety; Safety Management; Health; Hygiene; NASA Programs

19990040983 Bionetics Corp., Cocoa Beach, FL USA

Occupational Health Program Performance Measures (Metrics)

Ferguson, Emmett B., Jr., Bionetics Corp., USA; Proceedings from the 1998 Occupational Health Conference: Benchmarking for Excellence; February 1999, pp. 98-101; In English; See also 19990040967; No Copyright; Avail: CASI; A01, Hardcopy; A03, Microfiche

Occupational Health Services are periodically re-justified to senior management. This process can best be accomplished by taking objective measurements of the services provided. There are three general categories of metrics, which are familiar, and are used formally, or informally to describe and justify services. They are: (1) Quality assurance metrics; (2) Productivity metrics; and (3) Outcome metrics. Patient satisfaction surveys and retrospective medical record audits help to measure quality and are important when used to reassure users of a concern for maintaining quality of local service. Both these types of metrics are important and should be thoughtfully collected for internal and local use. However, they are of very limited use in comparing services with those of other NASA Centers or Agencies. Counting the number of clinic visits and exams are measures of productivity and may be important when advocating for services locally. They may be presented as factors in justifying cost. Outcome measures often require a more intensive effort to collect and are more difficult to quantify, but they may be the most useful for our program management needs. Our challenge is to find a few performance measures that can be collected without extreme hardship on the

NASA Centers that are of significant use to demonstrate the value of providing Occupational Health Services and for comparing the effectiveness of those services with similar services in other Agencies.
Derived from text
Health; NASA Programs; Productivity; Quality Control

19990040985 Bionetics Corp., Cocoa Beach, FL USA
Physical Examination Nomenclature and Standardization
Ferguson, Emmett B., Jr., Bionetics Corp., USA; Proceedings from the 1998 Occupational Health Conference: Benchmarking for Excellence; February 1999, pp. 105-108; In English; See also 19990040967; No Copyright; Avail: CASI; A01, Hardcopy; A03, Microfiche

The purpose of this presentation is to introduce a draft document for consideration and review. The NASA Occupational Health Program proposes usage of the following categories and definitions of physical examinations. These include: (1) Pre-Placement; (2) Surveillance; (3) Job Certification; (4) Health Maintenance; and (5) Special Purpose. Also included in the report are tables of NASA's Physical Examination Matrices.
Derived from text
Physical Examinations; Nomenclatures; Standardization

19990040986 NASA Kennedy Space Center, Cocoa Beach, FL USA
Employee Assistance Program Issues
Gettleman, Alan G., NASA Kennedy Space Center, USA; McGuire, William, Edgerton, Germeshausen and Grier, Inc., USA; Proceedings from the 1998 Occupational Health Conference: Benchmarking for Excellence; February 1999, pp. 109; In English; See also 19990040967; No Copyright; Avail: CASI; A01, Hardcopy; A03, Microfiche; Abstract Only; Abstract Only

Employee Assistance Program (EAP) officers, as well as personnel in other disciplines from eight NASA Centers, attended this breakout session. Ms. Brenda Blair, MA, CEAP, a guest speaker at the conference, also attended as a consultant. Representatives from the NASA Centers introduced themselves and spoke briefly about their programs. In a discussion related to the conference theme on benchmarking, quality control issues within the EAP community and adequate documentation of cases were addressed. Disposition and provision for quality assurance checks for EAP providers in single person offices were also discussed. Ms. Blair presented methods for consulting with other NASA personnel in single person EAP offices as a quality control measure. EAP intervention in critical incidents was discussed. The question of whether EAP assistance is an asset or a potential liability in those situations was addressed. Suggestions were made of topics for future EAP video-teleconference topics. A program on EAP ethics was planned for a September video teleconference. Each person was asked to provide intake forms they use to Mr. Gettleman or Ms. Blair. Ms. Blair said she would review the forms to ensure that adequate notification is provided to the client for confidentiality. She would also review them to ensure they have adequate limits of confidentiality--a topic for future video teleconferencing. Mr. Gettleman described the NASA initiative to reduce stresses in the workplace, and the activities of an ad-hoc EAP group that will make recommendations to NASA senior management. Alternative training methods were discussed for reaching target audiences such as employees at risk, supervisors, and others. Pfc. David A. Pendleton, Victim Assistance Coordinator, U.S. Capitol Police. U.S. House of Representatives made a special presentation. Pfc. Pendleton was on duty during the tragic shooting of two Federal guards at the U.S. Capitol. He related the events immediately after the incident. He described the nature and structure of the EAP's and the separate nature of the House and Senate programs. This episode was a particularly difficult situation as large numbers of tourists were involved. William S. Barry, MD, the new Manager of the NASA Occupational Health Program Office was introduced to those attending the breakout session.
Derived from text
Employee Relations; Personnel Management; Health; Personnel

19990040987 NASA Dryden Flight Research Center, Edwards, CA USA
Benchmarking for Excellence and the Nursing Process
Sleboda, Claire, NASA Dryden Flight Research Center, USA; Proceedings from the 1998 Occupational Health Conference: Benchmarking for Excellence; February 1999, pp. 110-111; In English; See also 19990040967; No Copyright; Avail: CASI; A01, Hardcopy; A03, Microfiche

Nursing is a service profession. The services provided are essential to life and welfare. Therefore, setting the benchmark for high quality care is fundamental. Exploring the definition of a benchmark value will help to determine a best practice approach.

A benchmark is the descriptive statement of a desired level of performance against which quality can be judged. It must be sufficiently well understood by managers and personnel in order that it may serve as a standard against which to measure value.
Derived from text
Standardization; Medical Services; Quality Control

19990040988 Bionetics Corp., Cocoa Beach, FL USA
NASA Occupational Health Procedures and Guidelines on Health Services for International Travel or Assignment
Ferguson, Emmett B., Jr., Bionetics Corp., USA; Proceedings from the 1998 Occupational Health Conference: Benchmarking for Excellence; February 1999, pp. 112-117; In English; See also 19990040967; No Copyright; Avail: CASI; A02, Hardcopy; A03, Microfiche

This NASA Occupational Health Procedures and Guidelines prescribes the responsibilities and procedures for safeguarding the health of NASA employees on international travel or assignment. The goal of the traveler health services is to prevent travel-related illness or mishap and promote effective management of health issues while on foreign travel. This document establishes the minimum traveler health program content. It is recognized that NASA Centers may have additional needs based on the specific number, composition, mission and destination of the traveling employees. This document should not limit NASA Centers from providing additional services in order to meet their unique requirements.
Derived from text
NASA Programs; Health; Medical Services; Travel; Procedures

19990040989 Bionetics Corp., Cocoa Beach, FL USA
RehabWorks at the Kennedy Space Center
Kirkland, Mary K., Bionetics Corp., USA; Proceedings from the 1998 Occupational Health Conference: Benchmarking for Excellence; February 1999, pp. 118-121; In English; See also 19990040967; No Copyright; Avail: CASI; A01, Hardcopy; A03, Microfiche

The topics of the Certified Athletic Trainer, the ”Industrial Athlete”, On-site athletic training, the training facility at KSC, and the success of RehabWorks at KSC is presented. Results and cost savings as a result of the facility are discussed.
Derived from text
Injuries; Personnel; Health; Physical Exercise

19990040990 Bionetics Corp., Cocoa Beach, FL USA
Health Risk Appraisal and Health Education Programs
Ferguson, Emmett B., Jr., Bionetics Corp., USA; Proceedings from the 1998 Occupational Health Conference: Benchmarking for Excellence; February 1999, pp. 122-123; In English; See also 19990040967; No Copyright; Avail: CASI; A01, Hardcopy; A03, Microfiche

An integral part of all NASA Center Occupational Health Programs should be an effective Health Education Program (HEP). An effective HEP should focus resources on preventing premature or disabling health problems in those employees at greatest risk of developing preventable health problems. Resources can be used most effectively and efficiently if they can be identified and offered intervention as early as possible. The Health Risk Appraisal (HRA) is a standardized instrument used to stratify risks for cardiovascular, cerebrovascular and behavior-related illness in a population. The HRA should be acceptable to the subject and the user. It should be simple, easy to complete and inexpensive.
Derived from text
Health; Education; Risk

19990040991 NASA Kennedy Space Center, Cocoa Beach, FL USA
Kennedy Space Center Coronary Heart Disease Risk Screening Program
Tipton, David A., NASA Kennedy Space Center, USA; Scarpa, Philip J., NASA Kennedy Space Center, USA; Proceedings from the 1998 Occupational Health Conference: Benchmarking for Excellence; February 1999, pp. 124; In English; See also 19990040967; No Copyright; Avail: CASI; A01, Hardcopy; A03, Microfiche; Abstract Only; Abstract Only

The number one cause of death in the U.S. is coronary heart disease (CHD). It is probably a major cause of death and disability in the lives of employees at Kennedy Space Center (KSC) as well. The KSC Biomedical Office used a multifactorial mathematical formula from the Framingham Heart Study to calculate CHD risk probabilities for individuals in a segment of the KSC population that required medical evaluation for job certification. Those assessed to be high-risk probabilities will be targeted for intervention. Every year, several thousand KSC employees require medical evaluations for job related certifications. Most medical information for these evaluations is gathered on-site at one of the KSC or Cape Canaveral Air Station (CCAS) medical clinics. The formula

used in the Framingham Heart Study allows calculation of a person's probability of acquiring CHD within 10 years. The formula contains the following variables: Age, Diabetes, Smoking, Left Ventricular Hypertrophy, Blood Pressure (Systolic or Diastolic), Cholesterol, and HDL cholesterol. The formula is also gender specific. It was used to calculate the 10-year probabilities of CHD in KSC employees who required medical evaluations for job certifications during a one-year time frame. This KSC population was profiled and CHD risk reduction interventions could be targeted to those at high risk. Population risk could also be periodically reevaluated to determine the effectiveness of intervention. A 10-year CHD risk probability can be calculated for an individual quite easily while gathering routine medical information. An employee population's CHD risk probability can be profiled graphically revealing high risk segments of the population which can be targeted for risk reduction intervention. The small audience of NASA/contractor physicians, nurses and exercise/fitness professionals at the breakout session received the lecture very well. Approximately one third indicated by a show of hands that they would be interested in implementing a similar program at their NASA Center. Questions were asked pertaining to standardization for age, the validity of using the idealized male values also for the female population, and indications of the screening test's sensitivity and specificity.
Derived from text
Medical Services; Risk; Personnel; Heart Diseases; Surveys; Clinical Medicine

19990040992 NASA Kennedy Space Center, Cocoa Beach, FL USA
Industrial Hygiene Issues
Brisbin, Steven G., NASA Kennedy Space Center, USA; Proceedings from the 1998 Occupational Health Conference: Benchmarking for Excellence; February 1999, pp. 125-126; In English; See also 19990040967; No Copyright; Avail: CASI; A01, Hardcopy; A03, Microfiche; Abstract Only; Abstract Only

This breakout session is a traditional conference instrument used by the NASA industrial hygiene personnel as a method to convene personnel across the Agency with common interests. This particular session focused on two key topics, training systems and automation of industrial hygiene data. During the FY 98 NASA Occupational Health Benchmarking study, the training system under development by the U.S. Environmental Protection Agency (EPA) was deemed to represent a "best business practice." The EPA has invested extensively in the development of computer based training covering a broad range of safety, health and environmental topics. Currently, five compact disks have been developed covering the topics listed: Safety, Health and Environmental Management Training for Field Inspection Activities; EPA Basic Radiation Training Safety Course; The OSHA 600 Collateral Duty Safety and Health Course; and Key program topics in environmental compliance, health and safety. Mr. Chris Johnson presented an overview of the EPA compact disk-based training system and answered questions on its deployment and use across the EPA. This training system has also recently been broadly distributed across other Federal Agencies. The EPA training system is considered "public domain" and, as such, is available to NASA at no cost in its current form. Copies of the five CD set of training programs were distributed to each NASA Center represented in the breakout session. Mr. Brisbin requested that each NASA Center review the training materials and determine whether there is interest in using the materials as it is or requesting that EPA tailor the training modules to suit NASA's training program needs. The Safety, Health and Medical Services organization at Ames Research Center has completed automation of several key program areas. Mr. Patrick Hogan, Safety Program Manager for Ames Research Center, presented a demonstration of the automated systems, which are described by the following: (1) Safety, Health and Environmental Training. This system includes an assessment of training needs for every NASA Center organization, course descriptions, schedules and automated course scheduling, and presentation of training program metrics; (2) Safety and Health Inspection Information. This system documents the findings from each facility inspection, tracks abatement status on those findings and presents metrics on each department for senior management review; (3) Safety Performance Evaluation Profile. The survey system used by NASA to evaluate employee and supervisory perceptions of safety programs is automated in this system; and (4) Documentation Tracking System. Electronic archive and retrieval of all correspondence and technical reports generated by the Safety, Health and Medical Services Office are provided by this system.
Derived from text
Health; Hygiene; Training Devices; Industrial Safety; Safety Management

19990040993 Johnson Controls, Inc., Bay Saint Louis, MO USA
SSC Environmental Health Project Program
Brever, Denise C., Johnson Controls, Inc., USA; Proceedings from the 1998 Occupational Health Conference: Benchmarking for Excellence; February 1999, pp. 128-132; In English; See also 19990040967; No Copyright; Avail: CASI; A01, Hardcopy; A03, Microfiche

The Facility Operations and Support Services Contract Environmental Health Office provides Environmental Health service to all groups at Stennis Space Center. Over the past four years, we have grown from a staff of five to a staff of nine. We have gained three Environmental Engineers and an Environmental Health Specialist. In addition, our cost plus contract was converted to a

performance-based contract in August 1997. These factors coupled with an overall desire to operate more efficiently prompted us to improve our record keeping systems. Our intent is to demonstrate the capabilities and benefits of a customized automated information tracking system for Environmental Health data. We will present a demonstration of our Environmental Health Project (EHP) tracking program through the use of printed screen images with captions describing our documentation process. We will also provide a list of the benefits that we have derived from using this system.
Derived from text
Project Management; Environmental Quality; Health; Information Systems

19990040994 NASA Marshall Space Flight Center, Huntsville, AL USA
MSFC Respiratory Protection Services
CoVan, James P., NASA Marshall Space Flight Center, USA; Proceedings from the 1998 Occupational Health Conference: Benchmarking for Excellence; February 1999, pp. 133-135; In English; See also 19990040967; No Copyright; Avail: CASI; A01, Hardcopy; A03, Microfiche

An overview of the Marshall Space Flight Center Respiratory Protection program is provided in this poster display. Respiratory protection personnel, building, facilities, equipment, customers, maintenance and operational activities, and Dynatech fit testing details are described and illustrated.
Derived from text
Respiratory System; Medical Equipment; Respirators; Health

19990040996 University of South Florida, Saint Petersburg, FL USA
Predicting Return to Work in Patients with Coronary Heart Disease
Francois, Rony, University of South Florida, USA; David, Patricia, University of South Florida, USA; Proceedings from the 1998 Occupational Health Conference: Benchmarking for Excellence; February 1999, pp. 139-143; In English; See also 19990040967; No Copyright; Avail: CASI; A01, Hardcopy; A03, Microfiche

The prevalence of coronary heart disease in the USA is estimated at 13.49 million. It remains the leading cause of death, claiming 489,970 lives in 1993. The incidence of acute myocardial infarction is 1.5 million cases per year. Successful return to work by patients following a myocardial infarction (MI) could recuperate lost income, improve workplace productivity, and decrease the cost associated with cardiovascular disease. The ability to predict return to work would thus allow a more efficient use of increasingly limited resources. The purpose of this thesis was to design and test a new tool that physicians and others could use to more accurately assess the prospect of a person returning to work after a myocardial infarction. This new tool was based upon two previous scales (Jezer, 1959 and Schiller, 1971) and a literature review. to assess its validity, this scale was tested on 81 post-MI patients at the Bay Pines Veterans Hospital. They were surveyed by phone and/or had their charts reviewed. The patients were asked to answer 13 questions in the survey. The factors assessed included: age, current episodes of angina, working status at time of MI, educational level, perception of health, physical demands of their previous job, co-morbidity, disability/pension/social security benefits, sex, psychological status, cardiac rehabilitation participation, duration of angina, and current working status. For each factor, a numerical value of 0, 1, or 2, was assigned based on the patient's answer. These value changed for age (0, 1, 4) and sex (0, 2)). Each patient thus had a total score and was placed in one of four categories (I-IV). A 4x2 table was generated with two columns of working and non-working individuals. Four rows depicted categories I to IV. Each cell contained the number of patients falling into that Category and working status. A Chi square test was conducted to determine whether the various Categories indeed predicted the patients' current working status. At a p value of .05, the Chi square of 42.60 was statistically significant and the null hypothesis that the catecories were unrelated to return to work was rejected. A t-test was then conducted to compare the mean scores of patients presently working, versus those not currently working. At a p value of .05, and a critical t of 2.O, the obtained t value of 7.36 was statistically significant and the null hypothesis was again rejected. The 95% confidence interval was calculated to be 4.29 to 7.49. In other words, the total score of the patients who were not working was 4 to 7.5 points higher than those currently working. A regression analysis revealed that the full model of the predictive rating scale had an overall accuracy of 95.06%. A backward elimination procedure identified current angina, baseline employment status, co-morbidity, and benefits as the key predictors of successful return to work. A model based only on these variables was also 95.06% accurate in its predictive accuracy. This rating scale appears to be a valid tool in the prediction of return to work in patients with coronary heart disease. Testing of this scale on a larger sample of female and male patients will help establish its validity and assess its reliability.
Author
Myocardial Infarction; Predictions; Productivity; Statistical Tests

19990040999 National Inst. for Occupational Safety and Health, Cincinnati, OH USA

Lead Poisoning in a Construction Company: Science Effecting Policy

Hales, Thomas R., National Inst. for Occupational Safety and Health, USA; McCammon, C., National Inst. for Occupational Safety and Health, USA; Daniels, W., National Inst. for Occupational Safety and Health, USA; Lee, S., National Inst. for Occupational Safety and Health, USA; Proceedings from the 1998 Occupational Health Conference: Benchmarking for Excellence; February 1999, pp. 153-155; In English; See also 19990040967; No Copyright; Avail: CASI; A01, Hardcopy; A03, Microfiche

An estimated 1,000,000 construction workers are exposed to lead. Case studies and State occupational lead registries have documented the problem of lead poisoning in the construction industry. Despite this information, the construction industry has been exempt from the OSHA general industry lead standard, primarily due to economic and technical feasibility concerns. In 1991, a study of ”lead burners” at a construction company in Utah was undertaken to determine: (1) Airborne lead exposures; (2) Whether adverse health effects were occurring among employees; and (3) Whether this company could implement provisions of the OSHA general industry lead standard.

Derived from text

Lead Poisoning; Industrial Safety; Environment Pollution; Construction Industry; Feasibility Analysis

19990041000 Kelsey Seybold, Huntsville, AL USA

The Nurse Practitioner in NASA Occupational and Preventive Medicine Programs

Kiessling, Janet, Kelsey Seybold, USA; Proceedings from the 1998 Occupational Health Conference: Benchmarking for Excellence; February 1999, pp. 156-157; In English; See also 19990040967; No Copyright; Avail: CASI; A01, Hardcopy; A03, Microfiche

The NASA Marshall Space Flight Center has implemented a cost-effective benchmark of excellence in the integration of a nurse practitioner into the Center’s occupational and preventive medicine programs. This paper defines the position of nurse practitioner and describes the versatility, value added, and cost savings achievable by employing a nurse practitioner in NASA Center medical programs.

Derived from text

Health; Cost Effectiveness; NASA Programs; Medical Services

19990041003 NASA Lewis Research Center, Cleveland, OH USA

Chemical Hygiene Program

Mayor, Antoinette C., NASA Lewis Research Center, USA; Proceedings from the 1998 Occupational Health Conference: Benchmarking for Excellence; February 1999, pp. 164; In English; See also 19990040967; No Copyright; Avail: CASI; A01, Hardcopy; A03, Microfiche; Abstract Only; Abstract Only

The Chemical Management Team is responsible for ensuring compliance with the OSHA Laboratory Standard. The program at Lewis Research Center (LeRC) evolved over many years to include training, developing Standard Operating Procedures (SOPS) for each laboratory process, coordinating with other safety and health organizations and teams at the Center, and issuing an SOP binder. The Chemical Hygiene Policy was first established for the Center. The Chemical Hygiene Plan was established and reviewed by technical, laboratory and management for viability and applicability to the Center. A risk assessment was conducted for each laboratory. The laboratories were prioritized by order of risk, higher risk taking priority. A Chemical Management Team staff member interviewed the lead researcher for each laboratory process to gather the information needed to develop the SOP for the process. A binder containing the Chemical Hygiene Plan, the SOP, a map of the laboratory identifying the personal protective equipment and best egress, and glove guides, as well as other guides for safety and health. Each laboratory process has been captured in the form of an SOP. The chemicals used in the procedure have been identified and the information is used to reduce the number of chemicals in the lab. The Chemical Hygiene Plan binder is used as a training tool for new employees. LeRC is in compliance with the OSHA Standard. The program was designed to comply with the OSHA standard. In the process, we have been able to assess the usage of chemicals in the laboratories, as well as reduce or relocate the chemicals being stored in the laboratory. Our researchers are trained on the hazards of the materials they work with and have a better understanding of the hazards of the process and what is needed to prevent any incident. From the SOP process, we have been able to reduce our chemical inventory, determine and implement better hygiene procedures and equipment in the laboratories, and provide specific training to our employees. As a result of this program, we are adding labeling to the laboratories for emergency responders and initiating a certified chemical user program.

Derived from text

Hazardous Materials; Safety Management; Industrial Safety; Hygiene; Laboratories

19990041005 Bionetics Corp., Cocoa Beach, FL USA

The Effectiveness of an On-site Musculoskeletal Rehabilitation Program at the Kennedy Space Center

Nason, Erik T., Bionetics Corp., USA; Proceedings from the 1998 Occupational Health Conference: Benchmarking for Excellence; February 1999, pp. 166-169; In English; See also 19990040967; No Copyright; Avail: CASI; A01, Hardcopy; A03, Microfiche

This study gathered data using the employees that were treated at the Kennedy Space Center (KSC) RehabWorks program between July 1, 1997 and June 30, 1998. The study showed the time lapses between: 1) the patient's date of injury and the first doctor's visit; 2) first doctor's visit and first RehabWorks appointment; and 3) first RehabWorks visit and the discharge date. Also delineated were the most common body part injured, the most common injury type and the total number of visits. All results were differentiated between worker's compensation patients and non-worker's compensation patients. Analysis of the data reflected the effectiveness of the onsite musculoskeletal rehabilitation program known as RehabWorks.

Author

Injuries; Musculoskeletal System; Effectiveness; Physical Exercise

19990041009 Edgerton, Germeshausen and Grier, Inc., Cocoa Beach, FL USA

Evaluation of Cardiovascular Screening Retest for High Risk Employees: Update

Roth, Carol A., Edgerton, Germeshausen and Grier, Inc., USA; Proceedings from the 1998 Occupational Health Conference: Benchmarking for Excellence; February 1999, pp. 182-185; In English; See also 19990040967; No Copyright; Avail: CASI; A01, Hardcopy; A03, Microfiche

The Kennedy Space Center (KSC) Health Education and Wellness Program, initiated in 1984, is open to all employees at KSC and Cape Canaveral Air Station (CCAS) at no charge. The goals of the program are to make employees more aware of their health and to screen for early detection of health problems. These are achieved through training classes, worksite lectures, health screenings, informational health packets, individual counseling, pamphlets and videotapes. Prevention is the focus of the program. It is based on four principles: (1) Educate employees about their bodies and healthy lifestyles; (2) Help employees identify present problems and risks factors for potential problems; (3) Assist employees in the reduction or elimination of risk factors; and (4) Support employees in maintaining their healthy lifestyle through monitoring and evaluation. Every month a different health program is featured on a wide variety of topics.

Derived from text

Cardiovascular System; Health; Education; Risk; NASA Programs; Physiological Tests

19990041013 NASA Kennedy Space Center, Cocoa Beach, FL USA

Kennedy Space Center Coronary Heart Disease Risk Screening Program

Tipton, David A., NASA Kennedy Space Center, USA; Scarpa, Philip J., NASA Kennedy Space Center, USA; Proceedings from the 1998 Occupational Health Conference: Benchmarking for Excellence; February 1999, pp. 195-199; In English; See also 19990040967; No Copyright; Avail: CASI; A01, Hardcopy; A03, Microfiche

Coronary heart disease (CHD) is the number one cause of death in the U.S. It is a likely cause of death and disability in the lives of employees at Kennedy Space Center (KSC) as well. The KSC Biomedical Office used a multifactorial formula developed by the Framingham Heart Study to calculate CHD risk probabilities for individuals in a segment of the KSC population who require medical evaluation for job certification. Those individuals assessed to have a high risk probability will be targeted for intervention.

Derived from text

Coronary Artery Disease; Risk; Personnel

19990041014 NASA Johnson Space Center, Houston, TX USA

Monitoring and Modeling Astronaut Occupational Radiation Exposures in Space: Recent Advances

Weyland, Mark, Lockheed Martin Corp., USA; Golightly, Michael, NASA Johnson Space Center, USA; Proceedings from the 1998 Occupational Health Conference: Benchmarking for Excellence; February 1999, pp. 200; In English; See also 19990040967; No Copyright; Avail: CASI; A01, Hardcopy; A03, Microfiche; Abstract Only; Abstract Only

In 1982 astronauts were declared to be radiation workers by OSHA, and as such were subject to the rules and regulations applied to that group. NASA was already aware that space radiation was a hazard to crewmembers and had been studying and monitoring astronaut doses since 1962 at the Johnson Space Center. It was quickly realized NASA would not be able to accomplish all of its goals if the astronauts were subject to the ground based radiation worker limits, and thus received a waiver from OSHA to establish independent limits. As part of the stipulation attached to setting new limits, OSHA included a requirement to perform preflight dose projections for each crew and inform them of the associated risks. Additional requirements included measuring doses from various sources during the flight, making every effort to prevent a crewmember from exceeding the new limits, and

keeping all exposures As Low As Reasonably Achievable (a.k.a. ALARA - a common health physics principle). The assembly of the International Space Station (ISS) and its initial manned operations will coincide with the 4-5 year period of high space weather activity at the next maximum in the solar cycle. For the first time in NASA's manned program, US astronauts will be in orbit continuously throughout a solar maximum period. During this period, crews are at risk of significantly increased radiation exposures due to solar particle events and trapped electron belt enhancements following geomagnetic storms. The problem of protecting crews is compounded by the difficulty of providing continuous real-time monitoring over a period of a decade in an era of tightly constrained budgets. In order to prepare for ISS radiological support needs, the NASA Space Radiation Analysis Group and the NOAA Space Environment Center have undertaken a multiyear effort to improve and automate ground-based space weather monitoring systems and real-time radiation analysis tools. These improvements include a coupled, automated space weather monitoring and alarm system--SPE exposure analysis system, an advanced space weather data distribution and display system, and a high-fidelity space weather simulation system. In addition, significant new real-time space weather data sets, which will enhance the forecasting and now-casting of near-Earth space environment conditions, are being made available through unique NASA-NOAA-USAF collaborations. These new data sets include coronal mass ejection monitoring by the Solar and Heliospheric Observatory (SOHO) and in-situ plasma and particle monitoring at the L1 libration point by the Solar Wind Monitor (SWIM) and Advanced Composition Explorer (ACE) spacecraft. Advanced real-time radiation monitoring data from charged particle telescopes and tissue equivalent proportional counters will also be available to assist crew and flight controllers in monitoring the external and intravehicular radiation environment.
Author
Aerospace Environments; Solar Activity Effects; Radiation Dosage; Radiation Hazards; Solar Radiation

19990041017 Florida State Univ., Center for Biomedical and Toxicological Research, Gainesville, FL USA
Toxicology & Health-Based Risk Assessment: Applications in the Workplace
Teaf, Christopher M., Florida State Univ., USA; Proceedings from the 1998 Occupational Health Conference: Benchmarking for Excellence; February 1999, pp. 208-210; In English; See also 19990040967; No Copyright; Avail: CASI; A01, Hardcopy; A03, Microfiche

Although the term may not be universally familiar, "risk assessment" is practiced on a regular basis in the workplace, both in consideration of chemical and physical hazards. Occupational guidelines or standards, as promulcated by organizations such as OSHA or ACGIH, represent a fundamental form of risk assessment which defines the levels of acceptable exposure under assumptions of regular worker exposure. More specific forms of risk assessment are based upon specific "exposure estimation" that seeks to carefully define the actual duration and magnitude of exposure to an individual under a particular set of conditions. Exposure details will determine the estimate of intake, or absorption, and hence the associated potential health risk. Simply put, the mere presence of a chemical in the environment does not necessarily indicate that harm will occur. That determination can only be made on the basis of the case-specific exposure characterization.
Derived from text
Toxicology; Risk; Toxic Hazards; Exposure

53
BEHAVIORAL SCIENCES

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

19990039548 Army Aeromedical Research Lab., Fort Rucker, AL USA
Evaluation of a Standardized Spatial Disorientation Flight Profile
Feb. 1999; 20p; In English
Report No.(s): AD-A361470; USAARL-99-04; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This study was designed to examine the feasibility of using visual-vestibular mismatch software to produce disorienting events in flight within a standardized simulator flight profile. Data were examined in order to ensure that collection of standard flight performance measures was not interrupted by the addition of disorienting events. Twenty-one UH-6O qualified Army aviators flew a 1-hour UH-60 simulator flight profile containing three visual-vestibular mismatch events (visual and vestibular divergence used, 4 degrees per sec with pitch, 6 degrees per sec with roll, and 8 degrees per sec with drift) . Following the flight, aviators filled out a simulator sickness questionnaire and rated each event in terms of difficulty of aircraft control recovery.
DTIC
Flight Characteristics; Aircraft Control; Disorientation; Motion Sickness

54
MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

Includes human engineering; biotechnology; and space suits and protective clothing. For related information see also 16 Space Transportation.

19990039553 Biodynamic Research Corp., San Antonio, TX USA
A PC-Based Head-Spine Model, HSM-PC
Jan. 1999; 29p; In English
Report No.(s): AD-A361392; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The Head Spine Model (HSM) was originally developed by the USAF Aeromedical Research Laboratory during the late seventies. The HSM was created to aid the solution of problems related to spinal loads resulting from ejection seat acceleration. Unfortunately, the original researchers who developed and used the HSM left the Government and the original code has not been maintained or used in research for several years. Biodynamic Research Corporation contracted with the USAF to create a computer model of the dynamic response of the human head and spine that executes on a PC compatible computer under a Windows environment The HSM-PC is aimed at creating simulations of the biomechanical responses of the head and spine to potentially traumatic impulsive acceleration and impact events.
DTIC
Computerized Simulation; Spinal Cord; Head (Anatomy)

19990039571 Department of Energy, Assistant Secretary for Management and Administration, Washington, DC USA
Reusability study with organic vapor air-purifying respirator cartridges
Wood, G. O., Department of Energy, USA; Kissane, R., Department of Energy, USA; Nov. 30, 1997; 8p; In English; Chemical and Biological Defense Research, 1997, USA; Sponsored by Army Edgewood Arsenal, USA
Report No.(s): DE98-002926; LA-UR-97-4458; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The question often arises about the reusability of organic vapor adsorption beds, such as air- purifying respirator cartridges, after periods of storage without use (airflow). The extremes of practice are: (1) use once and discard or (2) reuse multiple times assuming the protection is still afforded. The goal is to develop data and a model to provide guidance to decide when reuse is acceptable. They have studied the loss of protection of a commercial organic vapor cartridge after storage for varying periods of time. Three vapors (ethyl acetate, methylene chloride, and hexane) were individually loaded onto test cartridges using a breathing pump. Extents of loading, times of loading, and vapor concentrations were varied. After selected periods of storage the cartridges were again challenged with the same vapor concentration. The increases in concentration of a vapor in the effluent air (simulated breaths) from a cartridge immediately upon reuse depended on the storage period, the extent of loading during initial use, the volatility of the vapor, and the water vapor adsorbed, but not much on the vapor concentration.
NTIS
Respirators; Service Life; Water Vapor; Organic Materials; Purification; Cartridges; Adsorption

19990040183 Biodynamic Research Corp., San Antonio, TX USA
A Personal Computer-Based Head-Spine Model ***Final Report, May 1996 - Sep. 1998***
Pancratz, David J.; Rogers, Linda J.; Bomar, John B., Jr; Sep. 1998; 139p; In English
Report No.(s): AD-A361188; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

Biodynamic Research Corporation (BRC) of San Antonio, TX, completed an SBIR Phase II project to port the Air Force's Head-Spine Model (HSM) to a personal computer environment, improve certain features of the software, and add a user-friendly interface. The impetus for this project was the Air Force's desire to have a software tool capable of modeling the internal forces and motions of the human head and spine during impulsive acceleration events, particularly aircraft ejections. Although models exist to predict the gross motion of a human under acceleration loading, such as the Air Force Articulated Total Body (ATB) model, Dynaman, and MADYMO, the Head-Spine Model is the only tool able to provide estimates of internal forces. For this reason, the HSM could be valuable to the Air Force and other scientists for simulating acceleration environments.
DTIC
Human-Computer Interface; Head (Anatomy); Biodynamics; Computer Techniques; Spinal Cord

19990040218 Army Research Lab., Human Research and Engineering Directorate, Aberdeen Proving Ground, MD USA
Aviator Behavior and Performance as Affected by Aircrew Life Support and Protective Equipment
Waugh, John D.; Fatkin, Linda T.; Patton, Debra J.; Mullins, Linda L.; Burton, Pamela A.; Mar. 1999; 110p; In English; Original contains color plates

Contract(s)/Grant(s): Proj-1L161110274A
Report No.(s): AD-A361321; ARL-MR-440; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

A methodology for quantifying Army rotary wing aviator performance as influenced by aircrew life support, survival, and nuclear-biological-chemical clothing and equipment ensembles was examined in a set of experimental trials conducted in an AH-64 (Apache) combat mission simulator. The methodology was based on an aircrew evaluation procedure originally developed for use in the crew coordination training of all Army aviators. It uses a set of 13 basic qualities, each with behavioral anchors and a 7-point rating scale, and it is administered by specifically trained senior aviator evaluators. Ten crews, two aviators in each, while fully encumbered, performed three combat missions for record, representative of typical operational tasks, with one ”variation” trial conducted without the over-water components of the ensemble. Measures of effectiveness and flight data, as well as stress assessment and equipment ”complaints” citations, were recorded. The results indicated that the behavior-anchored scores were not sensitive enough to statistically discriminate among the independent variables of repeated measures and the variation trials even though graphically, differences were readily apparent. Attempts to apply transformations to the data, based on the aviator subjects' relative flying experience and their apparent accommodation to the trials were also statistically unsuccessful. The additional measures collected did not yield statistically significant discriminations nor did they correlate well with the evaluation score. A number of options for improving the technique are offered.
DTIC
Protective Clothing; Aircraft Pilots

19990040400 Armstrong Lab., Aerospace Medicine Directorate, Brooks AFB, TX USA
Testing and Evaluation of the Modified Gentex Mask Assembly in the Hyperbaric Environment ***Final Report, Feb. 1996 - Apr. 1997***
Massa, Thomas V.; Apr. 1998; 20p; In English
Report No.(s): AD-A361226; AL-AO-BR-TR-1998-0038; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Since the late 1970's Air Force hyperbaric facilities have been utilizing the MBU 5/P aviator's mask with a unique hyperbaric adapter assembly as a way to safely exhaust exhaled breathing gas from inside a high pressure chamber to ground level ambient pressure. Although the MBU 5/P mask, developed in the 1950's, is still available through depot, the modified adapter assembly is not. In order to purchase additional units, the adapter assembly must be re-milled at considerable expense to the government. Recently developed mask technology has evolved new systems which may provide increased comfort and reduced maintenance at less cost to the government. The Modified Gentex Mask Assembly (MGMA) was evaluated by hyperbaric technologists at 3.0, 2.4 and 2.0 ATA using a pressure demand regulator, pressure transducers and a mass spectrometer to determine if the MGMA could physiologically maintain levels of inspired oxygen while also exhausting expired carbon dioxide and other exhaled gases to ambient pressure. Equipment testing has identified the MGMA as a suitable substitute for implementation at Air Force and possibly civilian hyperbaric facilities. Inspiratory and expiratory gas analysis indicate the MGMA and current A-14 regulator constitute a highly efficient oxygen delivery system for hyperbaric use. MGMA met or exceeded industry standards established by Sheffield, Stork and Morgan. Currently, the MGMA is being modified for improvements by the Gentex Corporation.
DTIC
Oxygen Masks; Oxygen Supply Equipment; Aircraft Pilots; Breathing Apparatus; Gas Mixtures

19990040660 NASA Marshall Space Flight Center, Huntsville, AL USA
Human Factors Engineering at Marshall Space Flight Center
Dunn, M. C., NASA Marshall Space Flight Center, USA; Hutchinson, Sonya L., NASA Marshall Space Flight Center, USA; 1999; 8p; In English; 25th, 24-28 Mar. 1999, Kansas City, MO, USA; Sponsored by California State Univ., USA; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The mission of NASA Marshall Space Flight Center (MSFC) is to develop, implement, and maintain systems for space transportation and microgravity research. Factors impacting the MSFC position as a leader in advancing science and technology include: (1) heightened emphasis on safety; (2) increased interest in effective resource utilization; and (3) growing importance of employing systems and procedures that pragmatically support mission science. In light of these factors, MSFC is integrating human factors engineering (HFE) into the systems engineering process. This paper describes the HFE program, applications of HFE in MSFC projects, and the future of HFE at MSFC.
Author
Human Factors Engineering; Product Development; Research and Development; Microgravity; Safety

19990040859 NASA Marshall Space Flight Center, Huntsville, AL USA

Using Virtual Simulations in the Design of 21st Century Space Science Environments

Hutchinson, Sonya L., NASA Marshall Space Flight Center, USA; Alves, Jeffery R., Sigmatech, Inc., USA; 1996; 8p; In English; Technical Professional Conference, 24-28 Mar. 1999, Kansas City, MO, USA; Sponsored by California State Univ., USA; Original contains color illustrations; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Space Technology has been rapidly increasing in the past decade. This can be attributed to the future construction of the International Space Station (ISS). New innovations must constantly be engineered to make ISS the safest, quality, research facility in space. Since space science must often be gathered by crew members, more attention must be geared to the human's safety and comfort. Virtual simulations are now being used to design environments that crew members can live in for long periods of time without harmful effects to their bodies. This paper gives a few examples of the ergonomic design problems that arise on manned space flights, and design solutions that follow NASA's strategic commitment to customer satisfaction. The conclusions show that virtual simulations are a great asset to 21st century design.

Author

Simulation; Safety; International Space Station; Comfort; Aerospace Engineering

19990040910 Defence Science and Technology Organisation, Combatant Protection and Nutrition Branch, Melbourne, Australia

A Methodology for Measuring the Physiological Strain of Enhanced Soldiers: The 1998 Soldier Combat System Enhancement Study

Amos, Denys, Defence Science and Technology Organisation, Australia; Cotter, James D., Defence Science and Technology Organisation, Australia; Lau, Wai-Man, Defence Science and Technology Organisation, Australia; Forbes, Christopher H., Defence Science and Technology Organisation, Australia; November 1998; In English; Original contains color illustrations

Report No.(s): DSTO-TR-0747; DODA-AR-010-678; Copyright; Avail: Issuing Activity (DSTO Aeronautical and Maritime Research Lab., PO Box 4331, Melbourne, Victoria 3001, Australia), Hardcopy, Microfiche

The prime objective of the 1998 Soldier Combat System Enhancement Study was to assess, develop and verify methods to evaluate the physiological performance of dismounted soldiers with basic or enhanced capabilities conducting routine operations in the tropics. Core temperature, mean skin temperature and heart rate are appropriate measures for evaluating the physiological burden of soldier combat system enhancements. Current techniques for measuring mean skin temperature and heart rates are adequate. The measurement of core temperature using rectal thermistors has significant limitations, especially during vigorous activities. Studies of the hydration status of soldiers can be conducted using relatively straightforward methods to determine water intake, weight loss, urine production, and total sweat rate by weight differences. For field studies of hydration, there may be no need to analyse urine for sodium; specific gravity is more easily measured and appears to provide adequate information on hydration status. The robustness of the Metamax used for VO2 measurements was demonstrated and provided real time measurements of oxygen consumption, and of metabolic stress associated with activities.

Author

Body Temperature; Combat; Heart Rate; Physiology; Skin Temperature (Biology); Temperature Measurement; Time Measurement; Procedures

19990040938 Institute for Human Factors TNO, Soesterberg, Netherlands

Asymmetrical Tracking Accuracy in Three Translational Degrees of Freedom ***Final Report Asymmetrische Tracking Prestatie bij drie Translatoire Vrijheidsgraden***

vanErp, J. B. F., Institute for Human Factors TNO, Netherlands; Oving, A. B., Institute for Human Factors TNO, Netherlands; Jan. 23, 1998; 35p; In English

Contract(s)/Grant(s): B97-031; Proj. 788.1

Report No.(s): TD98-0009; TM-98-8002; Copyright; Avail: Issuing Activity (TNO Human Factors Research Inst., Kampweg 5, 3769 De Soesterberg, The Netherlands), Hardcopy, Microfiche

Recent developments in the domain of 3D visualization ask for control devices with three or more degrees of freedom. Applications can be encountered within CAD/CAM applications, virtual environments, computer games, but also within the remote control of devices and platforms. to integrate two or more degrees of freedom (for example, three translational degrees of freedom) has some potential advantages. The question, however, is how accurate operators can control the different degrees of freedom with such an integrated device. Former experiments report tracking errors in the depth dimension which are up to 4 times larger than on the other two dimensions. The cause for this may be found in two systems. First, it might be found in the visual system, in which the missing depth cues result in performance degradation. Second, it might be found in the motor system because not all axes may be controlled with the same accuracy. Usually, not much attention is given to the motor component. Sometimes, even a description of the specific coupling between motor and visual dimension lacks. Earlier in the present research project, it

was claimed that two compatible control-display mappings exist for the translational degrees of freedom in 3D: spatial-motion mapping, and reference-frame mapping. In the former, motions of device and object are always parallel in 3D, in the latter motions of device and object are always equal in respect to their respective reference planes, which are differently orientated in common situations (for example, a table with a mouse and a monitor). Both mappings lead to the coupling of a different motor component to the depth dimension of the display: up-down and forward- backward, respectively. Both mappings are tested with a pursuit and compensatory task, which enables the separation of the visual and the motor component. Besides this, the effects of additional visual depth cues is investigated. The results show that in the present experiment the visual component causes by far the largest part of the effects. The tracking error in the visual depth dimension is about four times larger than those on the other dimensions. The effect of the motor component is less, it causes a 10 percent enlarged tracking error in the up-down axis, but it is consistent over different couplings with the visual dimension. Providing additional visual depth cues in the display leads to a decrease of the tracking error on the visual depth dimension. However, no stereoscopic views were provided, while this may be the strongest depth cue. There are no differences between the pursuit and compensatory tracking task, which may be due to the more experience when executing the latter task.
Author
Asymmetry; Accuracy; Degrees of Freedom; Three Dimensional Models; Visual Stimuli; Pursuit Tracking

19990040981 NASA Johnson Space Center, Houston, TX USA
Medical Aspects of Space Walking
Musgrave, Story, NASA Johnson Space Center, USA; Proceedings from the 1998 Occupational Health Conference: Benchmarking for Excellence; February 1999, pp. 92-93; In English; See also 19990040967; No Copyright; Avail: CASI; A01, Hardcopy; A03, Microfiche

Dr. Musgrave has acquired extensive experience during a distinguished and impressive career that includes flying as an astronaut on six Shuttle missions, participating in many hours of extravehicular activity, and contributing his myriad talents toward great public service, especially in the area of education. He has a unique perspective as a physician, scientist, engineer, pilot, and scholar. His interests and breadth of knowledge, which astound even the seasoned space enthusiast, have provided the space program an extraordinary scientific and technical expertise. Dr. Musgrave presented a personal perspective on space flight with particular emphasis on extravehicular activity (EVA or space walking), which was copiously illustrated with photographs from many space missions. His theme was two fold: the exacting and detailed preparations required for successful execution of a mission plan and a cosmic view of mankind's place in the greater scheme of things.
Derived from text
Astronauts; Extravehicular Activity; Medical Phenomena; Space Maintenance

19990040997 Edgerton, Germeshausen and Grier, Inc., Cocoa Beach, FL USA
A Follow-up Study of Ergonomic Evaluations Performed at KSC/CCAS in 1997
Geyer, Bart, Edgerton, Germeshausen and Grier, Inc., USA; Proceedings from the 1998 Occupational Health Conference: Benchmarking for Excellence; February 1999, pp. 144-147; In English; See also 19990040967; No Copyright; Avail: CASI; A01, Hardcopy; A03, Microfiche

As awareness concerning ergonomics has increased, injuries resulting from ergonomic hazards are becoming more recognized in the Kennedy Space Center (KSC) and Cape Canaveral Air Station (CCAS) workplace. This increased awareness has led to greater numbers of KSC/CCAS personnel reporting to KSC medical facilities with symptoms related to ergonomic problems in their workplace. In response to these medical visits, the Base Operations Contractor (BOC, EG&G Florida Inc.) Industrial Hygiene (IH) Office initiates an ergonomic evaluation of the patient's workplace. In the 1997 calendar year, the EG&G IH Office completed 72 ergonomic workplace evaluations. Following these evaluations, recommendations were provided to the employee on how to minimize or eliminate ergonomic hazards at their workplace. For this study, a follow-up evaluation was performed on the 72 personnel evaluated in 1997. The follow-up entailed: (1) determining if improvements had been implemented to alleviate or correct the identified ergonomics hazards(s); (2) determining if those improvements were effective; and (3) identifying various trends in the implementation of the recommendations provided at the completion of the evaluations. The objective of this study was to aid the BOC IH Office in developing a focused ergonomic program management plan and associated program implementation strategies, which would reduce the number of ergonomic injuries and minimize ergonomic hazards at KSC and CCAS.
Derived from text
Human Factors Engineering; Industrial Safety; Workstations

19990041002 Bionetics Corp., Cocoa Beach, FL USA

A Comparison of the Effects of Various Exercise Programs on the Reduction of Body Fat

Mathews, Cristy L., Bionetics Corp., USA; Symons, Chris A., Bionetics Corp., USA; Arnold, Arthur A., Bionetics Corp., USA; Woodard, Daniel, Bionetics Corp., USA; Merz, Marion P., Bionetics Corp., USA; Deppensmith, Barbara, Bionetics Corp., USA; Ghiotto, Deborah, Bionetics Corp., USA; DiBiase, Cathy, Bionetics Corp., USA; Proceedings from the 1998 Occupational Health Conference: Benchmarking for Excellence; February 1999, pp. 159-163; In English; See also 19990040967; No Copyright; Avail: CASI; A01, Hardcopy; A03, Microfiche

The interrelationships that exist between exercise and reduction of body fat have been well established. A number of studies have reported that people who exercise have a reduction in body fat. One of the studies by Ballor & Keesey was a meta-analysis of 53 studies that looked at exercise induced changes in body composition. This study looked at aerobic exercise (walk/run & bike) and weight training and found that all forms of exercise reduced body fat. However, much of the research does not compare different types of exercise to the greatest loss of body fat. The following study was conducted to determine the effect of specific fitness programs on body fat. The changes in body fat due to the type of activity allowed inferences to be made regarding the type of exercise program that produces the greater body fat reduction.

Derived from text

Physical Exercise; Physical Examinations; Body Weight; Fats

19990041006 NASA Kennedy Space Center, Cocoa Beach, FL USA

Health Physics Innovations Developed During Cassini for Future Space Applications

Nickell, Rodney E., Edgerton, Germeshausen and Grier, Inc., USA; Rutherford, Theresa M., Edgerton, Germeshausen and Grier, Inc., USA; Marmaro, George M., NASA Kennedy Space Center, USA; Proceedings from the 1998 Occupational Health Conference: Benchmarking for Excellence; February 1999, pp. 170-177; In English; See also 19990040967; No Copyright; Avail: CASI; A02, Hardcopy; A03, Microfiche

The long history of space flight includes missions that used Space Nuclear Auxiliary Power devices, starting with the Transit 4A Spacecraft (1961), continuing through the Apollo, Pioneer, Viking, Voyager, Galileo, Ulysses, Mars Pathfinder, and most recently, Cassini (1997). All Major Radiological Source (MRS) missions were processed at Kennedy Space Center/Cape Canaveral Air Station (KSC/CCAS) Launch Site in full compliance with program and regulatory requirements. The cumulative experience gained supporting these past missions has led to significant innovations which will be useful for benchmarking future MRS mission ground processing. Innovations developed during ground support for the Cassini mission include official declaration of sealed-source classifications, utilization of a mobile analytical laboratory, employment of a computerized dosimetry record management system, and cross-utilization of personnel from related disciplines.

Author

Cassini Mission; Health Physics; Radiation Dosage; Nuclear Auxiliary Power Units; Safety Management

19990041010 NASA Kennedy Space Center, Cocoa Beach, FL USA

The Need to Reevaluate Nonresponding Ergonomic Patients

Scarpa, Philip J., NASA Kennedy Space Center, USA; Field, Steven A., NASA Kennedy Space Center, USA; Proceedings from the 1998 Occupational Health Conference: Benchmarking for Excellence; February 1999, pp. 186-187; In English; See also 19990040967; No Copyright; Avail: CASI; A01, Hardcopy; A03, Microfiche

The Kennedy Space Center (KSC) Environmental Health (EH) contractor performs ergonomic evaluations under its Ergonomic Program. Any KSC employee may request one or the reviewing physician may request one for a patient during a visit to an onsite medical facility. As part of the ergonomic evaluation, recommendations are given to the patient to help reduce any ergonomic problems they experience. The recommendations, if implemented, are successful in the majority of KSC patients; however, a group of patients do not seem to improve. Those who don't improve may be identified by reevaluations, which are performed to implement maximum resolution of ergonomic problems.

Derived from text

Human Factors Engineering; Health; Injuries; Medical Services

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MATHEMATICAL AND COMPUTER SCIENCES (GENERAL

19990040867 Institut des Hautes Etudes Scientifiques, Bures-sur-Yvette France
Higher ETA Invariants and the Novikov Conjecture on Manifolds with Boundary 2
Leichtnam, E.; Piazza, P.; May 1998; 20p; In English
Report No.(s): PB99-122244; IHES/M/98/40; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Contents include the following: Introduction; Riemannian fibration, signature operators and symmetric spectral sections; z(sub k)-Galois covering and higher eta forms; Manifolds with boundary and higher signatures; On the homotopy invariance of the canonical index class; Noncommutative symmetric spectral sections; Higher eta invariants and higher p-invariants for signature operators; The absolute Novikov conjecture on manifolds with boundary; The gap case; Futher Remarks.
NTIS
Boundaries; Homotopy Theory; Invariance; Riemann Manifold

60
COMPUTER OPERATIONS AND HARDWARE

Includes hardware for computer graphics, firmware, and data processing. For components see 33 Electronics and Electrical Engineering.

19990040411 Boeing Co., Huntsville, AL USA
Maintenance and Repair Support System (MARSS) ***Final Report, Apr. 1995 - Dec. 1997***
Wessling III, Francis; Feb. 1999; 56p; In English
Contract(s)/Grant(s): DAAK60-95-C-2029
Report No.(s): AD-A361219; MDC98W5164; NATICK-TR-99/017; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

The Defense Advanced Research Project Agency (DARPA), in conjunction with the U.S. Army Soldier Systems Center (SSC), U.S. Army Test Maintenance Diagnostics Equipment Activity (TMDA), and the McDonnell Douglas Corporation, a wholly owned subsidiary of the Boeing Company, developed the first Pentium class body-wearable computer. Under the DARPA-funded NATICK Contract DAAK60-95-C-2029, the McDonnell Douglas Corporation researched, designed, developed, built, and tested an advanced portable tactical information assistant called the Maintenance and Repair Support System (MARSS). The MARSS system established a revolutionary approach to the human/machine interface for information systems. The need for the system is derived from the increasing complexity of weapon systems and the reduction in armed forces personnel. Portable multimedia information systems are required to access information from remote locations, enhance mobility while referencing information, decrease required training of personnel, and increase operational readiness by decreasing- repair time for weapon systems. The Maintenance and Repair Support System (MARSS) is a body-worn portable information computing system that allows the user to access needed information hands-free.
DTIC
Maintenance; Man Machine Systems; Information Systems; Computers; Weapon Systems; Support Systems

19990040641 International Trade Commission, Washington, DC USA
In the Matter of Certain Hardware Logic Emulation Systems and Components Thereof. Investigation No. 337-TA-383. Sanctions Proceeding
Jan. 1999; 58p; In English
Report No.(s): PB99-130080; USITC/PUB-3154; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

This patent-based section 337 investigation was instituted on March 8, 1996, based upon a complaint and motion for temporary relief filed on January 26, 1996, by Quickturn Design Systems, Inc. ('Quickturn'). 61 Fed. Reg. 9486 (March 8, 1996). The respondents are Mentor Graphics Corporation ('Mentor') and Meta Systems ('Meta') (collectively 'respondents'). On July 8, 1996, the presiding administrative law judge ('ALJ') issued an initial determination ('TEO ID') granting Quickturn's motion for temporary relief. On August 5, 1996, the Commission determined not to modify or vacate the TEO ID and issued a temporary limited exclusion order and a temporary cease and desist order against domestic respondent Mentor. The Commission imposed a bond of 43 percent of entered value on respondents' importations and sales of emulation systems and components thereof during the remaining pendency of the investigation. On September 24, 1997, the Commission determined to modify respondents' temporary relief bond in the investigation. Respondents' temporary relief remained at 43 percent of the entered value of the subject

imported articles if the entered value equals transaction value as defined in applicable U.S. Customs Service regulations. Respondents' temporary relief bond increased to 180 percent of the entered value of the subject imported articles if the entered value is not based on transaction value.
NTIS
Hardware; International Trade; Logic Design

19990040646 ViA, Inc., Northfield, MN USA
Project Plan, *1 Nov. 1998 - 31 Jan. 1999*
Case, Steven; Dini, Paolo; Feb. 26, 1999; 111p; In English
Contract(s)/Grant(s): N00421-97-C-1293
Report No.(s): AD-A361374; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

ViA, Inc., has conducted a search of existing technology for the development of a wrist interactive device (WID). This DARPA-funded device will provide a compact, wearable interface to ViA's wearable computers and other hardware platforms. ViA's wearable computers (such as the ViA II) are worn around the waist, whereas the WID will be worn on the wrist. The WID will have the following functionality: (1) display of PC screen with VGA resolution or better; -(2)two-way voice communication; (3) paging; and (4) several hours of operation. to achieve this functionality, the WID will include the following components: (1) miniature display with magnifying optics that provide a large virtual image; (2) speaker/microphone with corresponding audio CODEC; (3) KF interface chipset (4) buzzer/vibrator; (5) map reader; (6) battery; and (7) microprocessor to manage the entire system.
DTIC
Wrist; Research; Voice Communication; Project Planning; Display Devices; Computers; Applications Programs (Computers)

19990041046 New Mexico State Univ., Klipsch School of Electrical and Computer Engineering, Las Cruces, NM USA
Design of a Channel Error Simulator using Virtual Instrument Techniques for the Initial Testing of TCP/IP and SCPS Protocols
Horan, Stephen, New Mexico State Univ., USA; Wang, Ru-Hai, New Mexico State Univ., USA; Apr. 01, 1999; 34p; In English; Original contains color illustrations
Contract(s)/Grant(s): NAG5-1491
Report No.(s): NMSU-ECE-99-002; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

There exists a need for designers and developers to have a method to conveniently test a variety of communications parameters for an overall system design. This is no different when testing network protocols as when testing modulation formats. In this report, we discuss a means of providing a networking test device specifically designed to be used for space communications. This test device is a PC-based Virtual Instrument (VI) programmed using the LabVIEW(TM) version 5 software suite developed by National Instruments(TM)TM. This instrument was designed to be portable and usable by others without special, additional equipment. The programming was designed to replicate a VME-based hardware module developed earlier at New Mexico State University (NMSU) and to provide expanded capabilities exceeding the baseline configuration existing in that module. This report describes the design goals for the VI module in the next section and follows that with a description of the design of the VI instrument. This is followed with a description of the validation tests run on the VI. An application of the error-generating VI to networking protocols is then given.
Derived from text
Design Analysis; Errors; Channels (Data Transmission); Simulators; Procedures; Electronic Equipment Tests

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COMPUTER PROGRAMMING AND SOFTWARE

Includes computer programs, routines, algorithms, and specific applications, e.g., CAD/CAM.

19990038370 Department of Energy, Washington, DC USA
Rigel: An interactive structured grid generation system
Hachfeld, W. D., Department of Energy, USA; Khamayseh, A. K., Department of Energy, USA; Hansen, G. A., Department of Energy, USA; Feb. 28, 1998; 8p; In English; Joint Thermophysics and Heat Transfer, USA; Sponsored by American Society of Mechanical Engineers, USA
Report No.(s): DE98-004661; LA-UR-97-4630; CONF-980610; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

An interactive structured grid generation application that facilitates the construction of complex, discretized, simulation models directly from the original Computer Aided Design (CAD) geometry specifications is presented. The application, named Rigel, reads physical model descriptions generated by modern CAD packages. Rigel includes a suite of interactive geometry editing functions to assist the user in the construction of a topologically correct geometry from the original CAD specification. Once a topologically correct geometry is created, an interactively steered grid generation capability is provided to facilitate the construction of an appropriate discretization for the simulation. Grid quality enhancement is supported with the application of user-directed elliptic smoothing, refinement, and coarsening operators. After a grid is completed, various output filters are supplied to write an input file for the target simulation code. This paper is intended to provide an overview of the mechanics of this process and to highlight some of the novel algorithms and techniques employed.
NTIS
Structured Grids (Mathematics); Grid Generation (Mathematics)

19990039097 Naval Postgraduate School, Monterey, CA USA
Re-Engineering and Prototyping a Legacy Software System - Janus Version 6.X
Williams, Julian R., Jr.; Saluto, Michael J.; Mar. 1999; 196p; In English
Report No.(s): AD-A361419; No Copyright; Avail: CASI; A09, Hardcopy; A03, Microfiche

The U.S. Army is working to develop future generations of constructive combat simulation systems that can take advantage of the wide availability of high-end Personnel Computers (PC). As part of this research and development process, the U.S. Army looked to re-engineer a verified and validated legacy combat simulation into a version that can operate on a PC using the industry supported and widely used Windows NT operating system. Janus, with its availability, familiarity, and applicability, will serve as that re-engineering test case. The re-engineered version of Janus will maintain its existing functionality, and include additional functionality to support Operations Other Than War (OOTW) and expanded Combat Service Support (CSS). In its final form, the results of this re-engineering project will produce the Warrior Simulation. Warrior will serve as a basis for future simulations. This thesis describes the re-engineering activities required to reconstruct the Janus architecture from a legacy software simulation system into one possessing an object-oriented architecture that complies with Department of Defense's (DoD) High Level Architecture (HLA) standard. This research indicates that procedural legacy simulations can be converted into an object-oriented architecture that complies with the HLA standards.
DTIC
Software Engineering; Object-Oriented Programming; Computerized Simulation; Combat

19990039170 NASA Marshall Space Flight Center, Huntsville, AL USA
Multi-Scale Fractal Analysis of Image Texture and Pattern
Emerson, Charles W., Southwest Missouri State Univ., USA; Lam, Nina Siu-Ngan, Louisiana State Univ., USA; Quattrochi, Dale A., NASA Marshall Space Flight Center, USA; Photogrammetric Engineering and Remote Sensing; January 1999; ISSN 0099-1112; Volume 65, No. 1, pp. 51-61; In English
Contract(s)/Grant(s): NAGw-4221; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

Analyses of the fractal dimension of Normalized Difference Vegetation Index (NDVI) images of homogeneous land covers near Huntsville, Alabama revealed that the fractal dimension of an image of an agricultural land cover indicates greater complexity as pixel size increases, a forested land cover gradually grows smoother, and an urban image remains roughly self-similar over the range of pixel sizes analyzed (10 to 80 meters). A similar analysis of LANDSAT Thematic Mapper images of the East Humboldt Range in Nevada taken four months apart show a more complex relation between pixel size and fractal dimension. The major visible difference between the spring and late summer NDVI images of the absence of high elevation snow cover in the summer image. This change significantly alters the relation between fractal dimension and pixel size. The slope of the fractal dimensional-resolution relation provides indications of how image classification or feature identification will be affected by changes in sensor spatial resolution.
Author
Agriculture; Fractals; Image Classification; Spatial Resolution; Thematic Mappers (LANDSAT); Vegetation

19990039205 Department of Energy, Office of Financial Management and Controller, Washington, DC USA
Graph-based system for network-vulnerability analysis
Swiler, L. P., Department of Energy, USA; Phillips, C., Department of Energy, USA; Jun. 30, 1998; 25p; In English; New Security Paradigms Workshop '98, 1998, USA
Report No.(s): DE98-005758; SAND-98-1127C; CONF-980914; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

This paper presents a graph-based approach to network vulnerability analysis. The method is flexible, allowing analysis of attacks from both outside and inside the network. It can analyze risks to a specific network asset, or examine the universe of possible consequences following a successful attack. The graph-based tool can identify the set of attack paths that have a high probability of success (or a low effort cost) for the attacker. The system could be used to test the effectiveness of making configuration changes, implementing an intrusion detection system, etc. The analysis system requires as input a database of common attacks, broken into atomic steps, specific network configuration and topology information, and an attacker profile. The attack information is matched with the network configuration information and an attacker profile to create a superset attack graph. Nodes identify a stage of attack, for example the class of machines the attacker has accessed and the user privilege level he or she has compromised. The arcs in the attack graph represent attacks or stages of attacks. by assigning probabilities of success on the arcs or costs representing level-of-effort for the attacker, various graph algorithms such as shortest-path algorithms can identify the attack paths with the highest probability of success.
NTIS
Computer Networks; Vulnerability; Network Analysis; Probability Theory; Detection

19990039207 Department of Energy, Washington, DC USA
Risk-based system refinement
Winter, V. L., Department of Energy, USA; Berg, R. S., Department of Energy, USA; Dalton, L. J., Department of Energy, USA; Jun. 30, 1998; 11p; In English
Report No.(s): DE98-005766; SAND-98-1283C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
When designing a high consequence system, considerable care should be taken to ensure that the system can not easily be placed into a high consequence failure state. A formal system design process should include a model that explicitly shows the complete state space of the system (including failure states) as well as those events (e.g., abnormal environmental conditions, component failures, etc.) that can cause a system to enter a failure state. In this paper the authors present such a model and formally develop a notion of risk-based refinement with respect to the model.
NTIS
Systems Engineering; System Failures; Risk; Abnormalities; Computer Programs

19990039547 Industrial Technology Inst., Ann Arbor, MI USA
The AARIA Agent Architecture: From Manufacturing Requirements-to Agent-Based System Design
Parunak, Van; Baker, Albert; Clark, Steve; Jan. 1998; 13p; In English; Prepared in cooperation with Cincinnati Univ., Cincinnati, OH.
Contract(s)/Grant(s): F33615-95-C-5524
Report No.(s): AD-A361476; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
Designs for real-world agent-based systems must reflect both domain requirements and technical capabilities. We illustrate requirements-based agent system engineering with a case study of AARIA (Autonomous Agents for Rock Island Arsenal), an industrial-strength agent-based shop-floor control and scheduling architecture being developed for an Army manufacturing facility.
DTIC
Software Engineering; Manufacturing; Industrial Plants; Systems Engineering

19990039554 Carnegie-Mellon Univ., Software Engineering Inst., Pittsburgh, PA USA
Third Product Line Practice Workshop Report *Final Report*
Bass, Len; Campbell, Grady; Clements, Paul; Northrop, Linda; Smith, Dennis; Mar. 1999; 47p; In English
Contract(s)/Grant(s): F19628-95-C-0003
Report No.(s): AD-A361391; CMU-SEI-99-TR-003; ESC*-TR-99-003; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
The Third Software Engineering Institute Product Line Practice Workshop was a hands-on meeting held in December 1998 to share industry practices in software product lines, to explore the technical and non-technical issues involved, and to evolve the SEl Product Line Practice Framework. This report synthesizes the workshop presentations and discussions, which described product line practices and analyzed issues in the areas of software engineering, technical management, and organizational management.
DTIC
Software Engineering; Engineering Management; Computer Programming

19990039561 California Univ., Sponsored Projects Office, Berkeley, CA USA

Hybrid Systems: Computation and Control ***Final Report***

Henzinger, Thomas A.; Sastry, Shankar; Feb. 17, 1999; 429p; In English

Contract(s)/Grant(s): DAAH04-96-1-0341

Report No.(s): AD-A361329; ARO-35873.91-MA-MUR; No Copyright; Avail: CASI; A19, Hardcopy; A04, Microfiche

This volume contains the proceedings of the First International Workshop on Hybrid Systems: Computation and Control, HSCC'98, organized April 13-15, 1998, at the University of California, Berkeley. The focus of the workshop is on mathematical methods for the rigorous and systematic design and analysis of hybrid systems. A hybrid system consists of digital devices that interact with analog environments. Driven by rapid advances in digital controller technology, hybrid systems are objects of investigation of increasing relevance and importance. The emerging area of hybrid systems research lies at the crossroads of computer science and control theory computer science contributes expertise on the digital aspects of a hybrid system, and control theory contributes expertise on the analog aspects. Since both research communities speak largely different languages, and employ largely different methods, a major purpose of the workshop is to bring together researchers from both disciplines. The workshop will also include demonstrations of software tools for the design, analysis, and simulation of hybrid systems.

DTIC

Computer Programs; Digital Systems; Conferences; Computation

19990039585 Department of Energy, Washington, DC USA

WinMod: An expert advisor for investment casting

Bivens, H. P., Department of Energy, USA; Williamson, G. A., Department of Energy, USA; Luger, G. F., Department of Energy, USA; Erdmann, R. G., Department of Energy, USA; Maguire, M. C., Department of Energy, USA; Apr. 30, 1998; 9p; In English; Artificial Intelligence and Manufacturing, 1998, USA

Report No.(s): DE98-005724; SAND-98-1006C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Investment casting is an important method for fabricating a variety of high quality components in mechanical systems. Cast components, unfortunately, have a large design and gate/runner build time associated with their fabrication. In addition, casting engineers often require many years of actual experience in order to consistently pour high quality castings. Since 1989, Sandia National Laboratories has been investigating casting technology and software that will reduce the time overhead involved in producing quality casts. Several companies in the casting industry have teamed up with Sandia to form the FASTCAST Consortium. One result of this research and the formation of the FASTCAST consortium is the creation of the WinMod software, an expert casting advisor that supports the decision making process of the casting engineer through visualization and advice to help eliminate possible casting defects.

NTIS

Casting; Technology Assessment; Research; Investment Casting

19990039586 National Science Foundation, Washington, DC USA

Multicriteria approximation through decomposition

Burch, C., National Science Foundation, USA; Krumke, S., National Science Foundation, USA; Marathe, M., National Science Foundation, USA; Phillips, C., National Science Foundation, USA; Sundberg, E., National Science Foundation, USA; Jun. 30, 1998; 20p; In English; 6th; Integer Programming and Combinatorial Optimization, USA; Sponsored by Department of Energy, USA

Report No.(s): DE98-005726; LA-UR-97-5198; CONF-980633; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The authors propose a general technique called solution decomposition to devise approximation algorithms with provable performance guarantees. The technique is applicable to a large class of combinatorial optimization problems that can be formulated as integer linear programs. Two key ingredients of their technique involve finding a decomposition of a fractional solution into a convex combination of feasible integral solutions and devising generic approximation algorithms based on calls to such decompositions as oracles. The technique is closely related to randomized rounding. Their method yields as corollaries unified solutions to a number of well studied problems and it provides the first approximation algorithms with provable guarantees for a number of new problems. The particular results obtained in this paper include the following: (1) the authors demonstrate how the technique can be used to provide more understanding of previous results and new algorithms for classical problems such as Multicriteria Spanning Trees, and Suitcase Packing; (2) they also show how the ideas can be extended to apply to multicriteria optimization problems, in which they wish to minimize a certain objective function subject to one or more budget constraints.

As corollaries they obtain first non-trivial multicriteria approximation algorithms for problems including the k-Hurdle and the Network Inhibition problems.
NTIS
Procedures; Algorithms; Decomposition; Combinatorial Analysis; Approximation

19990039598 Department of Energy, Washington, DC USA
Feeding a large-scale physics application to Python
Beazley, D. M., Department of Energy, USA; Lomdahl, P. S., Department of Energy, USA; Oct. 31, 1997; 11p; In English; 6th; Python, USA
Report No.(s): DE98-001537; LA-UR-97-3904; CONF-9710128; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The authors describe their experiences using Python with the SPaSM molecular dynamics code at Los Alamos National Laboratory. Originally developed as a large monolithic application for massive parallel processing systems, they have used Python to transform their application into a flexible, highly modular, and extremely powerful system for performing simulation, data analysis, and visualization. In addition, they describe how Python has solved a number of important problems related to the development, debugging, deployment, and maintenance of scientific software.
NTIS
Molecular Dynamics; Computer Programs

19990040216 Anthropology Research Project, Yellow Springs, OH USA
Automating Information Extraction from 3-D Scan Data ***Final Report, 4 Nov. 1997 - 14 Oct. 1998***
Bradtmiller, Bruce; Oct. 14, 1998; 56p; In English
Report No.(s): AD-A361314; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

The object of the research reported here was to evaluate the success of ARNScan versions 7.1 and 7.2, newly developed software for extracting body measurements from 3-D scans. Investigators used traditional methods to measure 123 male and female subjects for 21 dimensions associated with the sizing and design of military clothing. The same subjects were then scanned, and the same or comparable measurements extracted from the 3-D images. A comparison of the results obtained by each method yielded a number of differences. A variety of statistical procedures were then undertaken to establish whether these differences were important or significant; that is, were they large enough to place subjects in different sizes? Differences were tested against three standards: (1) acceptable measurer error established in the 1988 U.S. Army survey (ANSUR), (2) acceptable error estimated by three experienced tailors, and (3) garment grade in traditionally sized dress clothing. ARNScan fared well against the garment grade criterion; it did not do well against the ANSUR standard. The comparison produced mixed results with respect to the tailors' standards. ARNScan is still in the development stage and is currently being refined.
DTIC
Computer Programs; Measurement; Information Retrieval; Errors; Statistical Distributions

19990040223 Military Operations Research Society, Alexandria, VA USA
Mini-Symposium Report, Simulation Validation (SIMVAL) 1994
Parnell, Christine M.; Ross, Corrina; Mar. 10, 1999; 71p; In English
Report No.(s): AD-A361361; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

This publication is the final report of the Simulation Validation 1994 Mini-Symposium.
DTIC
Distributed Interactive Simulation; Simulation

19990040382 Department of Energy, Washington, DC USA
Patterns of change in design metaphor: A case study
Stubblefield, W. A., Department of Energy, USA; Apr. 30, 1998; 10p; In English; ACM Computer Human Interaction, USA
Report No.(s): DE98-003144; SAND-98-0129C; CONF-980414; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Design metaphors play an important role in the development of many software projects. However, the influence of metaphors on project functionality, design methodology and the interactions among members of the development team is not well under-

stood. This paper seeks insights into these issues by examining the experiences of a design team in building a system under the influence of a particularly strong design metaphor.
NTIS
Computer Programming; Computer Aided Design

19990040384 Department of Energy, Office of Financial Management and Controller, Washington, DC USA
Dynamic visualization techniques for high consequence software
Pollock, G. M., Department of Energy, USA; Feb. 28, 1998; 22p; In English; Aerospace, 1998, USA; Sponsored by Institute of Electrical and Electronics Engineers, USA
Report No.(s): DE98-003134; SAND-98-0426C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

This report documents a prototype tool developed to investigate the use of visualization and virtual reality technologies for improving software surety confidence. The tool is utilized within the execution phase of the software life cycle. It provides a capability to monitor an executing program against prespecified requirements constraints provided in a program written in the requirements specification language SAGE. The resulting Software Attribute Visual Analysis Tool (SAVAnT) also provides a technique to assess the completeness of a software specification. The prototype tool is described along with the requirements constraint language after a brief literature review is presented. Examples of how the tool can be used are also presented. In conclusion, the most significant advantage of this tool is to provide a first step in evaluating specification completeness, and to provide a more productive method for program comprehension and debugging. The expected payoff is increased software surety confidence, increased program comprehension, and reduced development and debugging time.
NTIS
Software Engineering; Computer Programming; Computer Programs

19990040405 ERIM International, Inc., Ann Arbor, MI USA
Computer Software End Product Documentation
Majewski, R.; Dec. 1998; 5p; In English
Contract(s)/Grant(s): N66001-97-C-000
Report No.(s): AD-A361247; ERIM-291300-19-H; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

The attached document provides the documentation for the CUP Source Code Delivery to NRAD. This document describes the Common UNIX Processor (CUP) Software source code delivery. The CUP image formation processor and GUI (v5.O) were delivered to NRaD/SPAWAR in both sourcecode and executable forms. This software was transmitted to NRaD/SPAWAR via Email as a UNIX tar save set that was compressed and then unencoded; the transfer was made in February 1997. This document assumes that the CUP software will be installed on a Sun UNIX workstation and that the host workstation is running the Solaris 2.5 or 2.6 operating system. The host workstation should also have the Sun Spareworks compiler package. CUP Configuration control is maintained by the Revision Control System (RCS), distributed by the Free Software Foundation. All UNIX makefiles in the CUP hierarchy use RCS commands to manipulate source code during compiling and linking.
DTIC
Computer Programs; Coding; Configuration Management

19990040407 NASA Ames Research Center, Moffett Field, CA USA
Time-Critical Volume Rendering *Final Report*
Kaufman, Arie, NASA Ames Research Center, USA; Apr. 24, 1998; 9p; In English
Contract(s)/Grant(s): NCC2-5231; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

For the past twelve months, we have conducted and completed a joint research entitled ”Time- Critical Volume Rendering” with NASA Ames. As expected, High performance volume rendering algorithms have been developed by exploring some new faster rendering techniques, including object presence acceleration, parallel processing, and hierarchical level-of-detail representation. Using our new techniques, initial experiments have achieved real-time rendering rates of more than 10 frames per second of various 3D data sets with highest resolution. A couple of joint papers and technique reports as well as an interactive real-time demo have been compiled as the result of this project.
Author
Research; Algorithms; Parallel Processing (Computers); Time Dependence

19990040415 BDM International, Inc., Albuquerque, NM USA

The Division Level Military Decision-Making Process (MDMP): Design and Development of a Prototype Computer-Based Training Product ***Final Report, Aug. - Dec. 1998***

Centric, James H.; Salter, Margaret S.; Mar. 1999; 22p; In English

Contract(s)/Grant(s): DASW01-98-F-1602; Proj-A790

Report No.(s): AD-A361259; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report documents the analysis, design, and development of the Division Level Military Decision-Making Process (MDMP) training product. The division level MDMP product is a computer-based, stand alone training support package envisioned to be used by the U.S. Army Command and General Staff College (CGSC) to augment existing CGSC instruction on the MDMP. The product, a computer disk, provides a self-paced, detailed discussion of the steps of the MDMP, focusing on the battle staff at the division-level. Field Manual 101-5 Staff Organization and Operations served as the doctrinal source reference. The course also contains selected tactics, techniques, and procedures (TTP) that aid the CGSC student in conducting staff integration and coordination during mission planning. This project was coordinated with the CGSC.

DTIC

Decision Making; Coordination; Computer Techniques; Computer Assisted Instruction

19990040531 Department of Energy, Washington, DC USA

Multicriteria Approximation Through Decomposition

Burch, C., Department of Energy, USA; Krumke, S., Department of Energy, USA; Marathe, M., Department of Energy, USA; Phillips, C., Department of Energy, USA; Sundberg, E., Department of Energy, USA; Dec. 31, 1997; 19p; In English; 6th; Integer Programming and Combinatorial Optimization, USA

Report No.(s): DE98-001686; SAND-97-3087C; CONF-980633; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The authors propose a general technique called solution decomposition to devise approximation algorithms with provable performance guarantees. The technique is applicable to a large class of combinatorial optimization problems that can be formulated as integer linear programs. Two key ingredients of the technique involve finding a decomposition of a fractional solution into a convex combination of feasible integral solutions and devising generic approximation algorithms based on calls to such decompositions as oracles. The technique is closely related to randomized rounding. The method yields as corollaries unified solutions to a number of well studied problems and it provides the first approximation algorithms with provable guarantees for a number of new problems. The particular results obtained in this paper include the following: (1) The authors demonstrate how the technique can be used to provide more understanding of previous results and new algorithms for classical problems such as Multicriteria Spanning Trees, and Suitcase Packing. (2) They show how the ideas can be extended to apply to multicriteria optimization problems, in which they wish to minimize a certain objective function subject to one or more budget constraints. As corollaries they obtain first non-trivial multicriteria approximation algorithms for problems including the k-Hurdle and the Network Inhibition problems.

NTIS

Approximation; Algorithms; Decomposition

19990040533 Department of Energy, Washington, DC USA

A Synchronous Paradigm for Modeling Semi-Passive Reactive Systems

Winter, V. L., Department of Energy, USA; Dec. 31, 1997; 13p; In English; Mathematics of Program Construction, USA

Report No.(s): DE98-001687; SAND-97-3105C; CONF-980634; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

This paper describes a modeling technique for single-agent reactive systems, that is influenced by the modeling paradigm of Parnas as well as by the synchronous paradigms of LUSTRE and ESTEREL. In this paradigm, single-agent reactive systems are modeled in a universe having a discrete clock. This discretization of time greatly reduces the temporal complexity of the model. According to the author, the advantage of this reduction in temporal complexity is that the resulting model is in many ways better suited to automated software construction and analysis techniques (e.g., deductive synthesis, transformation, and verification) than models that are based on continuous representations of time.

NTIS

Algorithms; Computer Systems Design; Software Engineering; Software Development Tools; Computer Programming

19990040540 Department of Energy, Office of Energy Research, Washington, DC USA
Fifth SIAM conference on geometric design 97: Final program and abstracts ***Final Report***
Dec. 31, 1997; 43p; In English
Report No.(s): DE99-000948; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The meeting was divided into the following sessions: CAD/CAM; Curve/ Surface Design; Geometric Algorithms; Multiresolution Methods; Robotics; Solid Modeling; and Visualization. This report contains the abstracts of papers presented at the meeting.

NTIS

Algorithms; Man Machine Systems; Geometry; Computer Graphics; Robotics

19990040559 Department of Energy, Assistant Secretary for Management and Administration, Washington, DC USA
Delta-f and hydrodynamic methods for semiconductor transport
Thode, L. E., Department of Energy, USA; Hotchkiss, R., Department of Energy, USA; Gray, M., Department of Energy, USA; Snell, C., Department of Energy, USA; Barnes, D., Department of Energy, USA; Dec. 31, 1998; 20p; In English
Report No.(s): DE99-000870; LA-UR-98-1440; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

This is the final report of a three-year, Laboratory Directed Research and Development (LDRD) project at Los Alamos National Laboratory. The authors have developed a prototype plug-and-play (PCUBED) environment based upon a C++ class called a fragment. A fragment is a universal object that can represent any data type. Fragments provide an excellent intuitive approach to the development of an efficient architecture, as well as providing a common data implementation within and between codes. As a result, the PCUBED environment allows for the generation of many different codes within a common framework. At this time, there are seven major codes implemented within the PCUBED environment. Input, output, restart, setup, and graphics are programmed using a high-level approach to insure human efficiency. In contrast, computationally intensive algorithms are programmed using a low-level approach to insure computational efficiency. Fragments provide a straightforward approach to switch between high-level and low-level programming. PCUBED has been tested on a Macintosh PowerPC; on IBM, SUN, HP, and SGI workstations; and on the CRAY YMP and Cray T3D. Using this environment, the authors have incorporated a drift diffusion, energy balance, hydrodynamic, and Monte Carlo model for metal-oxide semiconductor field-effect transistors (MOSFETs) into a single architecture. With all the models in a common framework, they have investigated the noise characteristics of hybrid and delta-f models. Although hybrid and delta-f models appear viable in one dimension, the noise level of higher order transport coefficients in two and three dimensions makes the utility of such combined methods questionable.

NTIS

Algorithms; Computer Programs; Monte Carlo Method; Semiconductors (Materials); Charge Carriers; Carrier Mobility

19990040594 NASA Langley Research Center, Hampton, VA USA
Large-Scale Parallel Unstructured Mesh Computations for 3D High-Lift Analysis
Mavriplis, D. J., Institute for Computer Applications in Science and Engineering, USA; Pirzadeh, S., NASA Langley Research Center, USA; 1999; In English; 37th; Aerospace Sciences, 11-14 Jan. 1999, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Report No.(s): AIAA Paper 99-0537; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

A complete ”geometry to drag-polar” analysis capability for three-dimensional high-lift configurations is described. The approach is based on the use of unstructured meshes in order to enable rapid turnaround for complicated geometries which arise in high-lift configurations. Special attention is devoted to creating a capability for enabling analyses on highly resolved grids. Unstructured meshes of several million vertices are initially generated on a work-station, and subsequently refined on a supercomputer. The flow is solved on these refined meshes on large parallel computers using an unstructured agglomeration multigrid algorithm. Good prediction of lift and drag throughout the range of incidences is demonstrated on a transport take-off configuration using up to 24.7 million grid points. The feasibility of using this approach in a production environment on existing parallel machines is demonstrated, as well as the scalability of the solver on machines using up to 1450 processors.

Author

Computational Fluid Dynamics; Computational Grids; Unstructured Grids (Mathematics); Grid Generation (Mathematics); Aerodynamic Drag; Lift

19990040693 Los Alamos National Lab., NM USA
Quantum algorithms for noncommutative hidden subgroups
Ettinger, M.; Hoeyer, P.; Dec. 31, 1998; 12p; In English; Foundations of computer science; Sponsored by Institute of Electrical and Electronics Engineers, USA

Report No.(s): DE99-000759; LA-UR-98-2010; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Quantum algorithms for factoring and discrete logarithm have previously been generalized to finding hidden subgroups of finite Abelian groups. This paper explores the possibility of extending this general viewpoint to finding hidden subgroups of non-commutative groups. The authors present a quantum algorithm for the special case of dihedral groups which determines the hidden subgroup in a linear number of calls to the input function. They also explore the difficulties of developing an algorithm to process the data to explicitly calculate a generating set for the subgroup. A general framework for the noncommutative hidden subgroup problem is discussed and they indicate future research directions.

NTIS

Algorithms; Quantum Mechanics; Subgroups; Commutation

19990040716 British Aerospace Aircraft Group, Military Aircraft and Aerostructures, Preston, UK

An Automated Method of Analysing Store Trajectory Simulations

Akroyd, G., British Aerospace Aircraft Group, UK; Aircraft Weapon System Compatibility and Integration; April 1999, pp. 2-1 - 2-11; In English; See also 19990040714; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

The use of 6 degree of freedom numerical methods for the simulation of store separation from combat aircraft is now widespread throughout the world. The simulations are usually validated against a limited set of flight trials and then the numerical models used to assess the store separation behaviour throughout the proposed release or jettison envelope. This method has the advantage that many tolerance conditions and 'what if' scenarios such as failure conditions can be studied safely and cost effectively. The simulations generally produce text output and graph plots of results for each case and often a trajectory 'picture' showing the store motion relative to the parent aircraft. Release cases are often time consuming to set up and even more time consuming to assess, especially as many tabulations or trajectory plots/graphical results have to be considered. At British Aerospace Military Aircraft, a simulation tool has been developed that allows models of high fidelity and accuracy to be created using a range of simulation techniques. The models can be created and executed using a graphical user interface and trajectories visualised in a 3D animation. An overview of the toolset known as STARS will be given in this paper. However, the real strength of the STARS system is the ability to run all the required tolerance cases in a batch mode with a range of post processing tools for automated analysis of the results. It is this ability that is the main focus of this paper.

Author

Computerized Simulation; External Store Separation; Trajectory Analysis; Systems Simulation; Dynamic Models; Applications Programs (Computers); Subroutine Libraries (Computers)

19990040761 Los Alamos National Lab., NM USA

Theoretical issues of computer simulations sequential dynamical systems

Barrett, C. L.; Mortveit, H. S.; Reidys, C. M.; Dec. 31, 1998; 9p; In English; 4th; ISAS '98: information systems analysis and synthesis

Report No.(s): DE99-001067; LA-UR-98-2235; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The authors study a class of discrete dynamical systems that is motivated by the generic structure of simulations. The systems consist of (a) a finite graph Y with vertex set (1,...,n) where each vertex has a binary state, (b) functions F(sub i):F2(sup n) -> F2(sup n) and (c) an update ordering (pi). The functions F(sub i) update the binary state of vertex i as a function of the state of vertex i and its Y-neighbors and leave the states of all other vertices fixed. The update ordering is a permutation of the Y-vertices. They derive a decomposition result, characterize invertible SDS and study fixed points. In particular, they analyze how many different SDS that can be obtained by reordering a given multiset of update functions and give a criterion for when one can derive concentration results on this number. Finally, some specific SDS are investigated.

NTIS

Computerized Simulation; Dynamical Systems

19990040792 Los Alamos National Lab., NM USA

IAEA Neutron Coincidence Counting (INCC) and the DEMING least-squares fitting programs

Krick, M. S.; Harker, W. C.; Rinard, P. M.; Wenz, T. R.; Lewis, W.; Dec. 31, 1998; 14p; In English; 39th; Institute of Nuclear Materials Management (INMM)

Report No.(s): DE99-001130; LA-UR-98-2378; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Two computer programs are described: (1) the INCC (IAEA or International Neutron Coincidence Counting) program and (2) the DEMING curve-fitting program. The INCC program is an IAEA version of the Los Alamos NCC (Neutron Coincidence Counting) code. The DEMING program is an upgrade of earlier Windows(reg-sign) and DOS codes with the same name. The versions described are INCC 3.00 and DEMING 1.11. The INCC and DEMING codes provide inspectors with the software sup-

port needed to perform calibration and verification measurements with all of the neutron coincidence counting systems used in IAEA inspections for the nondestructive assay of plutonium and uranium.
NTIS
Computer Programs; Inspection; Calibrating; Neutron Counters

19990041102 Rutherford Appleton Lab., Mathematical Software Group, Chilton, UK
The EVEREST Pre-Processor, 4.0
Ashby, J. V., Rutherford Appleton Lab., UK; Fowler, R. F., Rutherford Appleton Lab., UK; Greenough, C., Rutherford Appleton Lab., UK; Jan. 06, 1999; ISSN 1358-6254; In English
Report No.(s): RAL-TR-1998-083; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

In this report we describe the EVEREST Pre-Processor Module which forms part of the EVEREST suite of programs. The Pre-Processor Module of the EVEREST Suite provides a straightforward way of defining the geometrical structure of simple devices. Three basic mechanisms are provide: primitive commands, BLOCKS commands and STANDARD models. The Pre-Processor also provides commands to define contact surfaces and implant windows to be used by the Doping Profile Module. The module also includes a basic mesh generator and appropriate commands t o control the mesh density and distribution. The EVEREST suite is one of the products of the ESPRIT project EVEREST (ESPRIT 962E-17, Three- Dimensional Algorithms for a Robust and Efficient Semiconductor Simulator with Parameter Extraction). EVEREST was a four-year project supported by the European Community under the European Strategic Program for Research in Information Technology (ESPRIT) which is investigating suitable algorithms for the analysis of semiconductor devices in three dimensions, and developing software implementing the most effective of those algorithms.
Author
Computer Programs; Density Distribution; Information Systems; Semiconductor Devices

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COMPUTER SYSTEMS

Includes computer networks and special application computer systems.

19990039141 Department of Energy, Office of Energy Research, Washington, DC USA
Research toward a heterogeneous networked computing cluster
Duke, D. W., Department of Energy, USA; Green, T. P., Department of Energy, USA; Aug. 11, 1998; 5p; In English
Report No.(s): DE99-000956; DOE/ER/25147-T1; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Over the last year the Systems Development Group (SDG), has been involved in a number of projects. The primary projects include extending the UNIX version of DQS, a DCE version of DQS, a Java based queuing system, a Computer Aided Learning and Instruction model and working with the Florida Department of Law Enforcement in the formation of the Florida Computer Crime Center. Additionally SDG has assisted a number of state and local agencies. A synopsis of these projects is contained in this report.
NTIS
Heterogeneity; Systems Engineering; Computer Networks; Clusters

19990039633 Department of Energy, Washington, DC USA
Coarse-grid selection for parallel algebraic multigrid
Cleary, A., Department of Energy, USA; Jun. 01, 1998; 15p; In English; 5th; Solving Irregularly Structured Problems in Parallel, USA
Report No.(s): DE98-058631; UCRL-JC-130893; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The need to solve linear systems arising from problems posed on extremely large, unstructured grids has sparked great interest in parallelizing algebraic multigrid (AMG). to date, however, no parallel AMG algorithms exist. We introduce a parallel algorithm for the selection of coarse-grid points, a crucial component of AMG, based on modifications of certain parallel independent set algorithms and the application of heuristics designed to insure the quality of the coarse grids. A prototype serial version of the algorithm is implemented, and tests are conducted to determine its effect on multigrid convergence, and AMG complexity.
NTIS
Parallel Processing (Computers); Computational Grids; Heuristic Methods; Unstructured Grids (Mathematics)

19990040170 Carnegie-Mellon Univ., Software Engineering Inst., Pittsburgh, PA USA

Securing Network Servers

Ford, Gary; Allen, Julia; Alberts, Christopher; Fraser, Barbara; Hayes, Eric; Feb. 1999; 49p; In English

Contract(s)/Grant(s): F19628-95-C-0003

Report No.(s): AD-A361387; CMU/SEI-SIM-007; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The development of computer networks has resulted in an important class of computers: network servers. The primary purpose of these machines is to provide services, including both computational and data services, to other computers on the network. Because of their service role, it is common for servers to store many of an organization's most valuable and confidential information resources. They also are often deployed to provide a centralized capability for an entire organization, such as communication (electronic mail) or user authentication. Security breaches on a network server can result in the disclosure of critical information or the loss of a capability that can affect the entire organization. Therefore, securing network servers should be a significant part of your network and information security strategy. Many security problems can be avoided if servers and networks are appropriately configured. Default hardware and software configurations, however, are set by vendors who tend to emphasize features and functions more than security. Since vendors are not aware of your security needs, you must configure new servers to reflect your security requirements and reconfigure them as your requirements change. The practices recommended here are designed to help you configure and deploy network servers that satisfy your organization's security requirements. The practices may also be useful in examining the configuration of previously deployed servers.

DTIC

Information Systems; Computer Networks; Electronic Mail

19990040171 Carnegie-Mellon Univ., Software Engineering Inst., Pittsburgh, PA USA

Securing Desktop Workstations

Simmel, Derek; Ford, Gary; Allen, Julia; Alberts, Christopher; Fraser, Barbara; Feb. 1999; 57p; In English

Report No.(s): AD-A361388; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

This document is one of a series of publications of the Software Engineering Institute at Carnegie Mellon University called security improvement modules. They are intended to provide practical guidance to help organizations improve the security of their networked computer systems. Each module addresses an important but relatively narrowly defined problem in network and system security. The first section of the module describes the problem and outlines a set of security improvement practices to help solve it. Each practice is a recommended way of performing common tasks related to the secure operation of networked computer systems. The remaining sections of the module are detailed descriptions of the practices. Each includes a rationale for the recommended actions and a description of how to perform them. The practices are primarily written for system and network administrators whose day-to-day activities include installation, configuration, and maintenance of the computers and networks. Occasionally, practices are written to assist the managers responsible for network and system administration.

DTIC

Computer Networks; Software Engineering; Security

19990040385 Department of Energy, Office of Financial Management and Controller, Washington, DC USA

PNNI routing support for ad hoc mobile networking: The multilevel case

Martinez, L., Department of Energy, USA; Sholander, P., Department of Energy, USA; Tolendino, L., Department of Energy, USA; Jan. 31, 1998; 9p; In English

Report No.(s): DE98-003084; SAND-98-0206C; CONF-980209; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

This contribution extends the Outside Nodal Hierarchy List (ONHL) procedures described in ATM Forum Contributions 97-0766 and 97-0933. These extensions allow multiple mobile networks to form either an ad hoc network or an extension of a fixed PNNI infrastructure. A previous contribution (97-1073) covered the simplest case where the top-most Logical Group Nodes (LGNs), in those mobile networks, all resided at the same level in a PNNI hierarchy. This contribution covers the more general case wherein those top-most LGNs may reside at different PNNI hierarchy levels. Both of the SNL contributions consider flat ad hoc network architectures in the sense that each mobile network always participates in the PNNI hierarchy at the pre-configured level of its top-most LGN.

NTIS

Hierarchies; Local Area Networks

19990041053 NASA Lewis Research Center, Cleveland, OH USA

Network and User-Perceived Performance of Web Page Retrievals

Kruse, Hans, Ohio Univ., USA; Allman, Mark, Sterling Software, Inc., USA; Mallasch, Paul, NASA Lewis Research Center, USA; Proceedings of the First International Conference on Telecommunications; November 1998; In English; 1st; Telecommunications and Electronic Commerce, Nov. 1998, Nashville, TN, USA

Contract(s)/Grant(s): RTOP 632-50-5A; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

The development of the HTTP protocol has been driven by the need to improve the network performance of the protocol by allowing the efficient retrieval of multiple parts of a web page without the need for multiple simultaneous TCP connections between a client and a server. We suggest that the retrieval of multiple page elements sequentially over a single TCP connection may result in a degradation of the perceived performance experienced by the user. We attempt to quantify this perceived degradation through the use of a model which combines a web retrieval simulation and an analytical model of TCP operation. Starting with the current HTTP/l.1 specification, we first suggest a client@side heuristic to improve the perceived transfer performance. We show that the perceived speed of the page retrieval can be increased without sacrificing data transfer efficiency. We then propose a new client/server extension to the HTTP/l.1 protocol to allow for the interleaving of page element retrievals. We finally address the issue of the display of advertisements on web pages, and in particular suggest a number of mechanisms which can make efficient use of IP multicast to send advertisements to a number of clients within the same network.

Author

Network Analysis; Protocol (Computers); Mathematical Models

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CYBERNETICS

Includes feedback and control theory, artificial intelligence, robotics and expert systems. For related information see also 54 Man/System Technology and Life Support.

19990039123 Department of Energy, Office of Financial Management and Controller, Washington, DC USA

Trends in robotics: A summary of the Department of Energy's critical technology roadmap

Eicker, P. J., Department of Energy, USA; Aug. 10, 1998; 10p; In English; IMTS '98, 1998, USA

Report No.(s): DE98-006149; SAND-98-1834C; CONF-980927; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Technology roadmaps serve as pathways to the future. They call attention to future needs for research and development; provide a structure for organizing technology forecasts and programs; and help communicate technological needs and expectations among end users and the research and development (R and D) community. Critical Technology roadmaps, of which the Robotics and Intelligent Machines (RIM) Roadmap is one example, focus on enabling or cross-cutting technologies that address the needs of multiple US Department of Energy (DOE) offices. Critical Technology roadmaps must be responsive to mission needs of the offices; must clearly indicate how the science and technology can improve DOE capabilities; and must describe an aggressive vision for the future of the technology itself. The RIM Roadmap defines a DOE research and development path for the period beginning today, and continuing through the year 2020. Its purpose is to identify, select and develop objectives that will satisfy near- and long-term challenges posed by DOE's mission objectives. If implemented, this roadmap will support DOE's mission needs while simultaneously advancing the state-of-the-art of RIM. For the purposes of this document, RIM refers to systems composed of machines, sensors, computers and software that deliver processes to DOE operations. The RIM Roadmap describes how such systems will revolutionize DOE processes, most notably manufacturing, hazardous and remote operations, and monitoring and surveillance. The advances in DOE operations and RIM discussed in this document will be possible due to the developments in many other areas of science and technology, including computing, communication, electronics and micro-engineering. Modern software engineering techniques will permit the implementation of inherently safe RIM systems that will depend heavily on software.

NTIS

Robots; Artificial Intelligence; Technology Assessment; Research and Development; Robotics

19990039194 Department of Energy, Assistant Secretary for Management and Administration, Washington, DC USA

Multi-objective dynamic programming approach to constrained discrete-time optimal control

Driessen, B. J., Department of Energy, USA; Kwok, K. S., Department of Energy, USA; Sep. 30, 1997; 21p; In English; American Controls, 1998, USA

Report No.(s): DE98-000181; SAND-97-2147C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

This work presents a multi-objective differential dynamic programming approach to constrained discrete-time optimal control. In the backward sweep of the dynamic programming in the quadratic sub problem, the sub problem input at a stage or time step is solved for in terms of the sub problem state entering that stage so as to minimize the summed immediate and future cost subject to minimizing the summed immediate and future constraint violations, for all such entering states. The method differs from previous dynamic programming methods, which used penalty methods, in that the constraints of the sub problem, which may include terminal constraints and path constraints, are solved exactly if they are solvable; otherwise, their total violation is minimized. Again, the resulting solution of the sub problem is an input history that minimizes the quadratic cost function subject to being a minimizer of the total constraint violation. The expected quadratic convergence of the proposed algorithm is demonstrated on a numerical example.
NTIS
Dynamic Programming; Time Discrimination; Time Optimal Control

19990039198 Department of Energy, Assistant Secretary for Management and Administration, Washington, DC USA
Decentralized fuzzy control of multiple nonholonomic vehicles
Driessen, B. J., Department of Energy, USA; Feddema, J. T., Department of Energy, USA; Kwok, K. S., Department of Energy, USA; Sep. 30, 1997; 10p; In English
Report No.(s): DE98-000242; SAND-97-2352C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
This work considers the problem of controlling multiple nonholonomic vehicles so that they converge to a scent source without colliding with each other. Since the control is to be implemented on simple 8-bit microcontrollers, fuzzy control rules are used to simplify a linear quadratic regulator control design. The inputs to the fuzzy controllers for each vehicle are the (noisy) direction to the source, the distance to the closest neighbor vehicle, and the direction to the closest vehicle. These directions are discretized into four values: Forward, Behind, Left, and Right, and the distance into three values: Near, Far, Gone. The values of the control at these discrete values are obtained based on the collision-avoidance repulsive forces and the change of variables that reduces the motion control problem of each nonholonomic vehicle to a nonsingular one with two degrees of freedom, instead of three. A fuzzy inference system is used to obtain control values for inputs between the small number of discrete input values. Simulation results are provided which demonstrate that the fuzzy control law performs well compared to the exact controller. In fact, the fuzzy controller demonstrates improved robustness to noise.
NTIS
Navigation; Robots; Collision Avoidance; Simulation; Fuzzy Systems; Numerical Control

19990039204 Department of Energy, Assistant Secretary for Human Resources and Administration, Washington, DC USA
Limited fan-in optimal neural networks
Beiu, V., Department of Energy, USA; Makaruk, H. E., Department of Energy, USA; Draghici, S., Department of Energy, USA; Mar. 31, 1998; 15p; In English; 4th; Neutral Networks, USA
Report No.(s): DE98-004666; LA-UR-97-4314; CONF-971235; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
Because Very Large Scale Integration (VLSI) implementations do not cope well with highly interconnected nets the area of a chip growing as the cube of the fan-in, this paper analyzes the influence of limited fan in on the size and VLSI optimality of such nets. Two different approaches show that VLSI- and size-optimal discrete neural networks can be obtained for small (i.e. lower than linear) fan-in values. They have applications to hardware implementations of neural networks. The first approach is based on implementing a certain sub class of Boolean functions, IF(sub n,m) functions. The authors show that this class of functions can be implemented in VLSI optimal (i.e., minimizing AT(sup 2)) neural networks of small constant fan ins. The second approach is based on implementing Boolean functions for which the classical Shannon's decomposition can be used. They generalize the result presented there to arbitrary fan-in, and prove that the size is minimized by small fan in values, while relative minimum size solutions can be obtained for fan-ins strictly lower than linear. Finally, a size-optimal neural network having small constant fan-ins is suggested for IF(sub n,m) functions.
NTIS
Neural Nets; Optimization

19990039564 Army Research Lab., Sensors and Electron Devices Directorate, Adelphi, MD USA
Enhanced Target Identification Using Higher Order Shape Statistics ***Interim Report, Jan. - May 1997***
Wellman, Mark; Srour, Nassy; Feb. 1999; 26p; In English
Contract(s)/Grant(s): Proj. AH16
Report No.(s): AD-A361281; ARL-TR-1723; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The U.S. Army Research Laboratory (ARL) is developing an acoustic target classifier using a backpropagation neural network (BPNN) algorithm. Various techniques for extracting features have been evaluated to improve the confidence level and probability of correct identification (ID). Some techniques used in the past include simple power spectral estimates (PSEs), split-window peak picking, harmonic line association (HLA), principal component analysis (PCA), wavelet packet analysis, and others. In addition, improved classification results have been obtained when shape statistic features derived from HLA feature sets or seismic PSE features have been incorporated in BPNN training, testing, and cross-validation. The combined acoustic/seismic data from collocated acoustic and seismic sensors are gathered by a three-axis seismic sensor. This is configured as part of an acoustic sensor array that ARL uses on typical field experiments. The PSE, HLA, and shape statistic feature (SSF) data are extracted from a set of vehicles and then split into a testing and training file. The training file typically consists of 75 percent of the whole data set, and the performance of the trained neural network is evaluated using the remaining test data, and further cross-validation is performed with vehicle data collected at different times of day and various operating conditions. Results of the neural network from a few of the feature extraction algorithms currently under evaluation and from the acoustic/seismic sensor fusion are presented in this report.
DTIC
Neural Nets; Algorithms; Acoustic Properties; Acoustics; Classifiers; Target Acquisition; Pattern Recognition

19990039576 Department of Defense, Washington, DC USA
Simulations of embodied evolving semiosis: Emergent semantics in artificial environments
Rocha, L. M., Department of Defense, USA; Joslyn, C., Department of Defense, USA; Feb. 28, 1998; 9p; In English; Simulation Technology for Nuclear Power Plants and Systems, 1998, USA; Sponsored by Department of Energy, USA
Report No.(s): DE98-002932; LA-UR-97-4755; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
As we enter this amazing new world of artificial and virtual systems and environments in the context of human communities, we are interested in the development of systems and environments which have the capacity to grow and evolve their own meanings in the context of this community of interaction. In this paper the authors analyze the necessary conditions to achieve systems and environments with these properties: (1) a coupled interaction between a system and its environment; (2) an environment with sufficient initial richness and structure to allow for; (3) embodied emergent classification of that environment system coupling; and (4) which is subject to pragmatic selection.
NTIS
Artificial Intelligence; Simulation; Environments; Classifications

19990039614 NASA Lewis Research Center, Cleveland, OH USA
An Evaluation of TCP with Larger Initial Windows
Allman, Mark, NASA Lewis Research Center, USA; Hayes, Christopher, Lucent Technologies, USA; Ostermann, Shawn, Ohio Univ., USA; Computer Communication Review; Jul. 01, 1998; In English
Contract(s)/Grant(s): NAS3-27121; RTOP 632-50-5A; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche
Transmission Control Protocol (TCP's) slow start algorithm gradually increases the amount of data a sender injects into the network, which prevents the sender from overwhelming the network with an inappropriately large burst of traffic. However, the slow start algorithm can make poor use of the available band-width for transfers which are small compared to the bandwidth-delay product of the link, such as file transfers up to few thousand characters over satellite links or even transfers of several hundred bytes over local area networks. This paper evaluates a proposed performance enhancement that raises the initial window used by TCP from 1 MSS-sized segment to roughly 4 KB. The paper evaluates the impact of using larger initial windows on TCP transfers over both the shared Internet and dialup modem links.
Author
Evaluation; Algorithms; Local Area Networks; Internets; Protocol (Computers)

19990039619 Department of Energy, Washington, DC USA
Sentient networks
Chapline, G., Department of Energy, USA; Mar. 01, 1998; 16p; In English; 1st; Multisource-Multisensor Information Fusion, USA
Report No.(s): DE98-057694; UCRL-JC-130837; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
The engineering problems of constructing autonomous networks of sensors and data processors that can provide alerts for dangerous situations provide a new context for debating the question whether man-made systems can emulate the cognitive capabilities of the mammalian brain. In this paper we consider the question whether a distributed network of sensors and data processors can form 'perceptions' based on sensory data. Because sensory data can have exponentially many explanations, the use of

a central data processor to analyze the outputs from a large ensemble of sensors will in general introduce unacceptable latencies for responding to dangerous situations. A better idea is to use a distributed 'Helmholtz machine' architecture in which the sensors are connected to a network of simple processors, and the collective state of the network as a whole provides an explanation for the sensory data. In general communication within such a network will require time division multiplexing, which opens the door to the possibility that with certain refinements to the Helmholtz machine architecture it may be possible to build sensor networks that exhibit a form of artificial consciousness.
NTIS
Computer Networks; Neural Nets; Data Processing Equipment; Artificial Intelligence

19990040762 Sandia National Labs., Albuquerque, NM USA
Characterization of nonlinear dynamic systems using artificial neural networks
Urbina, A.; Hunter, N. F.; Paez, T. L.; Dec. 31, 1998; 10p; In English; 69th; Shock and vibration
Report No.(s): DE99-001064; SAND-98-2135C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
The efficient characterization of nonlinear systems is an important goal of vibration and model testing. The authors build a nonlinear system model based on the acceleration time series response of a single input, multiple output system. A series of local linear models are used as a template to train artificial neutral networks (ANNs). The trained ANNs map measured time series responses into states of a nonlinear system. Another NN propagates response states in time, and a third ANN inverts the original map, transforming states into acceleration predictions in the measurement domain. The technique is illustrated using a nonlinear oscillator, in which quadratic and cubic stiffness terms play a major part in the system's response. Reasonable maps are obtained for the states, and accurate, long-term response predictions are made for data outside the training data set.
NTIS
Neural Nets; Nonlinear Systems; Dynamical Systems

64
NUMERICAL ANALYSIS

Includes iteration, difference equations, and numerical approximation.

19990039556 Naval Surface Weapons Center, Dahlgren, VA USA
Mathematical Methods of Three-Dimensional Eye Rotations Based Upon Spacecraft Dynamics Notation ***Final Report***
Chun, Kee S.; Feb. 1999; 202p; In English
Report No.(s): AD-A361385; NSWCDD/MP-99/17; No Copyright; Avail: CASI; A10, Hardcopy; A03, Microfiche
This report shows tutorial derivations (a form of student's guide) of all key equations needed in the research of three-dimensional eye rotations, which happens to coincide with virtually all key equations needed to understand the rotational motions of spacecrafts and missiles. Considering the fact that mathematics may not be the primary field of competence for most medical researchers, the author of this report took special care to explain the derivations from a very elementary level and to gradually progress to advanced equations in a logical, self-containing way. The author introduces some innovative ways of explaining otherwise difficult concepts and derivations in several topics.
DTIC
Spacecraft; Eye Movements; Eye (Anatomy)

19990040404 Carnegie-Mellon Univ., Dept. of Computer Science, Pittsburgh, PA USA
Algorithm Evolution with Internal Reinforcement for Signal Understanding
Teller, Astri; Dec. 05, 1998; 163p; In English
Contract(s)/Grant(s): N00014-95-1-0591
Report No.(s): AD-A361241; CMU-CS-98-132; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche
Automated program evolution has existed in some form for almost forty years. Signal understanding (e.g., signal classification) has been a scientific concern for longer than that. Generating a general machine learning signal understanding system has more recently attracted considerable research interest. First, this thesis defines and creates a general machine learning approach for signal understanding independent of the signal's type and size. This is accomplished through an evolutionary strategy of signal understanding programs that is an extension of genetic programming. Second, this thesis introduces a suite of sub-mechanisms that increase the power of genetic programming and contribute to the understanding of the learning technique developed. The central algorithmic innovation of this thesis is the process by which a novel principled credit-blame assignment is introduced and incorporated into the evolution of algorithms, thus improving the evolutionary process. This principled credit-blame assignment

is done through a new program representation called neural programming and applied through a set of principled processes collectively called internal reinforcement in neural programming. This thesis concentrates on these algorithmic innovations in real world signal domains where the signals are typically large and/or poorly understood. This evolutionary learning of algorithms takes place in PADO, a system developed in this thesis for "parallel algorithm discovery and orchestration" and as a demonstrably effective strategy for divide-and-conquer in signal classification domains. This thesis includes an extensive empirical evaluation of the techniques developed in a rich variety of real-world signals. The results obtained demonstrate, among other things, the effectiveness of principled credit-blame assignment in algorithm evolution. This work is unique in three aspects.
DTIC
Algorithms; Computer Programming; Classifications; Domains

19990040419 Carnegie-Mellon Univ., Dept. of Computer Science, Pittsburgh, PA USA
Intensional Investigations
Dancanet, Denis R.; Jan. 1998; 172p; In English
Contract(s)/Grant(s): N00014-93-1-0750
Report No.(s): AD-A361291; CMU-CS-98-135; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche

This thesis is about the theory and practice of intensional semantics. Traditional denotational models of programming languages are usually extensional in that they concern themselves only with input/output properties of programs. The meaning of a program is typically taken to be a function from input to output containing no information about the way that function computes its result. In an intensional denotational semantics, the meaning of a program is an object embodying aspects of the computation strategy. The structure of the object varies, depending on the language one models and the intended usage. For instance, previous intensional semantics have been developed using functions on richer domains, pairs of a function and a computation strategy, and sequential algorithms, and they were used to reason about efficiency, complexity, order of evaluation, degrees of parallelism, efficiency-improving program transformations, and so on. In the first part of this thesis, we develop an intensional semantics based on abstract circuits. A program is mapped to a circuit, whose dimensions tell us how much parallel work and time is required to execute the program. We relate the circuit dimensions to various execution strategies, and to more traditional models of parallel execution such as the PRAM. Our main application for circuit semantics is the establishment of relative intensional expressiveness results. Extensional expressiveness is concerned with whether a construct enables us to compute new functions. Since most programming languages are Turing-complete this is usually not very interesting. On the other hand, intensional expressiveness is concerned with whether a construct enables us to write more efficient programs. Utilizing a somewhat surprising connection with the field of circuit complexity, we study the relative intensional expressive power of various deterministic and nondeterministic parallel extensions of PCF.
DTIC
Programming Languages; Semantics; Circuits; Domains

19990040529 NASA Lewis Research Center, Cleveland, OH USA
Development and Application of Rosenbrock-Wanner-Wolfbrandt Integrators
Iskovitz, Ilana Seiden, Ohio Aerospace Inst., USA; Freed, Alan D., NASA Lewis Research Center, USA; 1996; 14p; In English; No Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

A self-sufficient algorithm has been constructed by extending the classic fourth-order integrator of Kutta to a one-parameter family of Rosenbrock integrators of the Wanner-Wolfbrandt type for solving stiff and nonstiff systems of differential equations. An efficiency comparison has been performed for several values of this parameter. An interpolator permits dense output independent of the numerical pace. The impact of an analytical versus numerical Jacobian on the overall performance has been studied. The performance of the algorithm is demonstrated by solving stiff systems from viscoplasticity and chemical kinetics.
Author
Integrators; Algorithms; Runge-Kutta Method; Iterative Solution

19990040541 Department of Energy, Office of Energy Research, Washington, DC USA
Sixth SIAM conference on applied linear algebra: Final program and abstracts ***Final Report***
Dec. 31, 1997; 44p; In English
Report No.(s): DE99-000946; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Linear algebra plays a central role in mathematics and applications. The analysis and solution of problems from an amazingly wide variety of disciplines depend on the theory and computational techniques of linear algebra. In turn, the diversity of disciplines depending on linear algebra also serves to focus and shape its development. Some problems have special properties (numerical, structural) that can be exploited. Some are simply so large that conventional approaches are impractical. New computer architec-

tures motivate new algorithms, and fresh ways to look at old ones. This conference aimed to bring those with an interest in current developments in linear algebra together for discussion. Abstracts of papers presented are included.
NTIS
Current Algebra; Linear Programming; Conferences; Iterative Solution

19990040592 NASA Lewis Research Center, Cleveland, OH USA
Representing Tensor Functions With the Cholesky Transform
Freed, Alan D., NASA Lewis Research Center, USA; Jun. 06, 1997; 12p; In English; No Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

The tensor representation theorem provides a powerful tool for evaluating isotropic, tensor-valued, tensor functions. Efficient computational techniques exist when an analysis is being done in rectangular Cartesian coordinates. Introducing a Cholesky decomposition of the metric tensor permits the tensor polynomial of the tensor representation theorem, when expressed in curvilinear coordinates, to be transformed into a pseudo-Cartesian frame where these efficient algorithms apply.
Author
Tensors; Cholesky Factorization; Computation; Tensor Analysis; Spherical Coordinates

19990040760 Army Research Lab., Human Research and Engineering Directorate, Aberdeen Proving Ground, MD USA
A Finite Element Perspective in Analyzing Maxwell's Equation ***Final Report, Jul. 1998 - Feb. 1999***
Korjack, Thomas A.; Mar. 1999; 36p; In English
Report No.(s): AD-A361210; ARL-TR-1916; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

An analysis of the three-dimensional (3-D) finite element formulation of Maxwell's equations governing classical electromagnetic propagation in dielectrics is given including its analogy to Navier's equation. The weak form of the electric field equation is reviewed along with dispersion analysis and approximation equations. Radiation boundary conditions are also explored to include paraxial absorber, Sandier absorber, and other absorber comparisons. In addition, time domains vs. frequency domains are investigated with a listing of possible advantages and disadvantages. It was concluded that if large-scale calculations need to be done today, time-domain techniques provide the most practicable means; however, it is still premature to promote such solvers as production level tools for engineers.
DTIC
Finite Element Method; Electric Fields; Maxwell Equation

19990040838 Institute for Computer Applications in Science and Engineering, Hampton, VA USA
Solving Upwind-Biased Discretizations: Defect-Correction Iterations ***Final Report***
Diskin, Boris, Institute for Computer Applications in Science and Engineering, USA; Thomas, James L., Institute for Computer Applications in Science and Engineering, USA; March 1999; 26p; In English
Contract(s)/Grant(s): NAS1-97046; RTOP 505-90-52-01
Report No.(s): NASA/CR-1999-209106; NAS 1.26:209106; ICASE-99-14; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This paper considers defect-correction solvers for a second order upwind-biased discretization of the 2D convection equation. The following important features are reported: (1) The asymptotic convergence rate is about 0.5 per defect-correction iteration. (2) If the operators involved in defect-correction iterations have different approximation order, then the initial convergence rates may be very slow. The number of iterations required to get into the asymptotic convergence regime might grow on fine grids as a negative power of h. In the case of a second order target operator and a first order driver operator, this number of iterations is roughly proportional to h-1/3. (3) If both the operators have the second approximation order, the defect-correction solver demonstrates the asymptotic convergence rate after three iterations at most. The same three iterations are required to converge algebraic error below the truncation error level. A novel comprehensive half-space Fourier mode analysis (which, by the way, can take into account the influence of discretized outflow boundary conditions as well) for the defect-correction method is developed. This analysis explains many phenomena observed in solving non-elliptic equations and provides a close prediction of the actual solution behavior. It predicts the convergence rate for each iteration and the asymptotic convergence rate. As a result of this analysis, a new very efficient adaptive multigrid algorithm solving the discrete problem to within a given accuracy is proposed. Numerical simulations confirm the accuracy of the analysis and the efficiency of the proposed algorithm. The results of the numerical tests are reported.
Author
Convection; Correction; Iteration; Two Dimensional Models; Elliptic Differential Equations

65
STATISTICS AND PROBABILITY

Includes data sampling and smoothing: Monte Carlo method; and stochastic processes.

19990040219 Military Operations Research Society, Alexandria, VA USA
Advanced Distribution Simulation (ADS) for Analysis
Parnell, Christine M.; Feb. 23, 1999; 167p; In English
Report No.(s): AD-A361332; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche

This is the proceedings of the Advanced Distribution Simulation (ADS) for Analysis held in Williamsburg, Virginia on 30 January - 1 February 1996. Co-hosted by the Air Force Test and Evaluation Center, BDM International Inc., Sandia National Laboratory. For this particular Workshop, over 100 senior military and civilian analysts gathered in Williamsburg, VA, from 30 January to 1 February 1996 to have a frank discussion on the applicability/utility of ADS and Distributed Interactive Simulation (DIS) technologies to the analytical community and to document findings and recommendations resulting from the discussion. Much of the discourse that preceded the Workshop and continued through the initial Workshop sessions focused on the need for a definition for ADS. Ed Brady, FS, the General Chair, believed that any definition would restrict the potential applicability of ADS but finally proffered the following: Advanced Distributed Simulation - The evolving DoD distributed modeling and simulation (M&S) infrastructure, including synthetic environments, run-time infrastructures and connected human-in-the loop (HITL) simulations such as DIS.

DTIC
Distributed Interactive Simulation; Simulation

19990040570 Department of Energy, Office of Financial Management and Controller, Washington, DC USA
Efficient Monte Carlo Probability Estimation with Finite Element Response Surfaces Built from Progressive Lattice Sampling
Romero, V. J., Department of Energy, USA; Bankston, S. D., Department of Energy, USA; Mar. 10, 1998; 19p; In English; 39th; Structures, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Report No.(s): DE98-002809; SAND-98-0607C; CONF-980419; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The concept of ”progressive Lattice Sampling” as a basis for generating successive finite element response surfaces that are increasingly effective in matching actual response functions is investigated here. The goal is optimal response surface generation, which achieves an adequate representation of system behavior over the relevant parameter space of a problem with a minimum of computational and user effort. Such is important in global optimization and in estimation of system probabilistic response, which are both made much more viable by replacing large complex computer models of system behavior by fast running accurate approximations. This paper outlines the methodology for Finite Element/Lattice Sampling (FE/LS) response surface generation and examines the effectiveness of progressively refined FE/LS response surfaces in decoupled Monte Carlo analysis of several model problems. The proposed method is in all cases more efficient (generally orders of magnitude more efficient) than direct Monte Carlo evaluation, with no appreciable loss of accuracy. Thus, when arriving at probabilities or distributions by Monte Carlo, it appears to be more efficient to expand computer model function evaluations on building a FE/LS response surface than to expand them in direct Monte Carlo sampling. Furthermore, the marginal efficiency of the FE/LS decoupled Monte Carlo approach increases as the size of the computer model increases, which is a very favorable property.

NTIS
Monte Carlo Method; Finite Element Method; Probability Theory; Lattices (Mathematics); Sampling

66
SYSTEMS ANALYSIS

Includes mathematical modeling; network analysis; and operations research.

19990040222 Air Force Inst. of Tech., School of Engineering, Wright-Patterson AFB, OH USA
Development of an Operations Research Software Package for Army Divisions
Wilson, Blane C.; Dec. 1998; 159p; In English
Report No.(s): AD-A361356; AFIT/GOA/ENS/98D-01; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche

There exists great potential for applying operations research techniques to solve specific problems in the areas of operations, installation support, and training at the Army division level. Because of the operational tempo of today's active-duty and reserve component units, command must focus on accomplishing the daily missions. Also, due their limited knowledge of the field, planners may not be aware of how operations research can be used to enhance planning and operations. Time, training funds, resources, safety, personnel, and equipment are all critical factors in this process. Operations research techniques could be used to improve division-level operations by saving time, managing resources more efficiently, and helping leaders make sound decisions. This thesis research is designed to increase the awareness of how the use of operations research at the division level, can aid planners and decision-makers in solving real problems encountered on a daily basis, thus improving unit operations. by using Microsoft Excel, Visual Basic, and Microsoft Access, a software package was developed to assist division planners in solving problems encountered in such areas as transportation, risk management, fuel service, dining facilities, and shelf storage. Using the software package can result in division planners managing time and resources more effectively.
DTIC
Software Engineering; Operations Research

19990040736 Defence Evaluation Research Agency, Sensors and Processing Sector, Farnborough, UK
Air-to-Ground Weapon Aiming: A Brief Synopsis to Date and a Look to the Future
Edwards, K. L., Defence Evaluation Research Agency, UK; Loyd, S. J., Royal Air Force, UK; Ralph, J. F., Defence Evaluation Research Agency, UK; Aircraft Weapon System Compatibility and Integration; April 1999, pp. 26-1 - 26-12; In English; See also 19990040714; Copyright Waived; Avail: CASI; A03, Hardcopy; A03, Microfiche

A review of air-to-ground weapon aiming is given, with emphasis placed on the use of the Head-Up Display (HUD), the main cockpit instrument used for accurate weapon aiming over the last 35 years. Nevertheless, the HUD is only of use for the aiming of forward-firing weapons. More weapons have an off-axis capability and their aiming is greatly facilitated by the use of a Helmet-Mounted Sight (HMS) or Helmet-Mounted Display (HMD). The surface-to-air threat and the rules of engagement particularly in operations other than war, place high demands on the aircrew and the weapon aiming system, both to stand off from the target and to have a high degree of confidence that it is the target. The requirement to perform an accurate in-flight transfer alignment of the weapon places further demands upon the aircrew. Timely and accurate target data, digitally received, plus an on-board targeting system which can automatically search for and recognise a target, are of great utility in the final stages prior to weapon release. The Defence Evaluation and Research Agency is performing research in these areas.
Author
Weapons Delivery; Air to Surface Missiles; Head-Up Displays; Helmet Mounted Displays; Pilot Support Systems

67
THEORETICAL MATHEMATICS

Includes topology and number theory.

19990040426 Ohio State Univ., Dept. of Civil and Environmental Engineering and Geodetic Science, Columbus, OH USA
Artifacts Introduced in the Point Evaluation of Functions Expanded into a Degree 360 Spherical Harmonic Series
Rapp, Richard H., Ohio State Univ., USA; March 1999; 23p; In English
Contract(s)/Grant(s): NAS5-32352
Report No.(s): NASA/CR-1999-209205; NAS 1.26:209205; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

An expansion of a function initially given in 1 deg cells was carried out to degree 360 by using 30 min cells whose value was initially assigned to be the value of the 1 deg cell in which it fell. The evaluation of point values of the function from the degree 360 expansion revealed spurious patterns attributed to the coefficients from degree 181 to 360. Expansion of the original function in 1 deg cells to degree 180 showed no problems in the point evaluation. Mean 1 deg values computed from both degree 180 to

360 expansions showed close agreement with the original function. The artifacts could be removed if the 30 min values were interpolated by spline procedures from adjacent 1 deg cells. These results led to an examination of the gravity anomalies and geoid undulations from EGM96 in areas where 1 deg values were 'split up' to form 30 min cells. The area considered was 75 deg S to 85 deg S, 100 deg to 120 deg where the split up cells were basically south of 81 deg S. A small, latitude related, and possibly spurious effect might be detectable in anomaly variations in the region. These results suggest that point values of a function computed from a high degree expansion may have spurious signals unless the cell size is compatible with the maximum degree of expansion. The spurious signals could be eliminated by using a spline interpolation procedure to obtain the 30 min values from the 1 deg values.
Author
Gravity Anomalies; Geopotential; Earth Gravitation; Gravitational Fields; Spectrum Analysis; Geoids

19990040779 Wisconsin Univ., Dept. of Physics, Madison, WI USA
Controlling chaos in a high dimensional system with periodic parametric perturbations
Mirus, K. A.; Sprott, J. C.; Oct. 31, 1998; 11p; In English
Report No.(s): DE99-001038; DOE/ER/54345-308; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
The effect of applying a periodic perturbation to an accessible parameter of a high-dimensional (coupled-Lorenz) chaotic system is examined. Numerical results indicate that perturbation frequencies near the natural frequencies of the unstable periodic orbits of the chaotic system can result in limit cycles or significantly reduced dimension for relatively small perturbations.
NTIS
Perturbation; Chaos

70
PHYSICS (GENERAL)

For precision time and time interval (PTTI) see 35 Instrumentation and Photography; for geophysics, astrophysics or solar physics see 46 Geophysics, 90 Astrophysics, or 92 Solar Physics.

19990039542 NASA Marshall Space Flight Center, Huntsville, AL USA
Static Test for a Gravitational Force Coupled to Type 2 YBCO Superconductors
Li, Ning, NASA Marshall Space Flight Center, USA; Noever, David, Alabama Univ., USA; Robertson, Tony, Alabama Univ., USA; Koczor, Ron, Alabama Univ., USA; Brantley, Whitt, Alabama Univ., USA; Physica C; 1997; ISSN 0921-4534; Volume 281, pp. 260-267; In English; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche
As a Bose condensate, superconductors provide novel conditions for revisiting previously proposed couplings between electromagnetism and gravity. Strong variations in Cooper pair density, large conductivity and low magnetic permeability define superconductive and degenerate condensates without the traditional density limits imposed by the Fermi energy (approx. 10(exp -6) g cc. Recent experiments have reported anomalous weight loss for a test mass suspended above a rotating type II, YBCO superconductor, with the percentage change (0.05 - 2.1 %) independent of the test mass' chemical composition and diamagnetic properties. A variation of 5 parts per 10' was reported above a stationary (non-rotating) superconductor. In experiments using a sensitive gravimeter, bulk YBCO superconductors were stably levitated in a DC magnetic field. Changes in acceleration were measured to be less than 2 parts in 108 of the normal gravitational acceleration. This result puts new limits on the strength and range of the proposed coupling between static superconductors and gravity.
Author
Static Tests; Gravitation; YBCO Superconductors; Experimentation; Losses; Mass; Degeneration; Chemical Composition

19990039557 Air Force Inst. of Tech., Wright-Patterson AFB, OH USA
Numerical Solutions to the Two Dimensional Boltzmann Equation
Smithtro, Christopher G.; Mar. 1999; 110p; In English
Report No.(s): AD-A361382; AFIT/GAP/ENP/99M-13; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche
A strict kinetic, two-dimensional model of the electron kinetics within a glow discharge positive column is developed. The problem is solved in cylindrical geometry using the standard two-term Legendre expansion of the electron velocity distribution function. The model establishes a steady state solution, such that the net ionization rate is exactly balanced by the wall loss. In addition to a thorough analytic development, we present the numerical techniques used to solve the resulting elliptic partial differential equation, including an efficient method to treat sparse banded matrices. The model is validated against published results, local and nonlocal kinetic approximations, and a previous Monte Carlo treatment. Having created a working model, we conduct

an investigation into current flow within the solution area of a neon column, made possible by this 2-D treatment. Furthermore, we investigate the range of applicability of the earlier local and nonlocal kinetic approximations and finally present a short discussion on the effect different forms of wall loss have on the overall distribution function.
DTIC
Glow Discharges; Distribution Functions; Boltzmann Transport Equation

19990039658 NASA Marshall Space Flight Center, Huntsville, AL USA
Thermoconvective Instability in a Rotating Magnetic Field
Volz, M. P., NASA Marshall Space Flight Center, USA; Mazuruk, K., NASA Marshall Space Flight Center, USA; International Journal of Heat and Mass Transfer; 1999; ISSN 0017-9310; Volume 42, pp. 1037-1045; In English; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

The effect of a rotating magnetic field (RMF) on the stability of a fluid contained in a cylindrical column and heated from below is investigated. The RMF increases the critical Rayleigh number for asymmetric flow modes but does not affect the onset of instability for axisymmetric modes. The critical Rayleigh number is dependent upon the relative penetration of the magnetic field into the cylinder and the Prandtl number of the fluid. Instability first develops in the form of a single asymmetric meridional roll rotating around the axis of the cylinder, driven by the azimuthal component of the magnetic field.
Author
Magnetic Fields; Electromagnetic Fields; Convective Flow; Axisymmetric Flow; Flow Geometry; Flow Stability; Heat Transmission

19990040649 Kharkov State Univ., Research Inst. of Chemisty, USSR
Third International Kharkov Symposium "Physics and Engineering of Millimeter and Submillimeter Waves" MSMW 1998 Symposium Proceedings, Volume 1
Unger, H. G.; Shahabadi, M.; Schunemann, K.; Sep. 1998; 425p; In English; 3rd; Physics and Engineering of Millimeter and Submillimeter Waves, 15-17 Sep. 1998, Kharkov, Ukraine
Report No.(s): AD-A360972; No Copyright; Avail: CASI; A18, Hardcopy; A04, Microfiche

In this contribution, we present a review of the principles of holographic power combining, a new concept for power combining at millimeter and submillimeter wavelengths. This approach which is based on the principles of holography utilizes a computer-generated hologram to transform the wavefront radiated by an array of sources into a plane wave, and establishes spatial power combining. The primary advantages of this method are its scalability up to arbitrarily high frequencies, high combining efficiency, and broad-band characteristics. Moreover, it will be shown that a holographic power combiner has a simple structure, and its design shows no dependence on the number of sources. With regard to the above mentioned advantages, this powercombining technique can replace many of the common methods of power combining and open the way to all-solid-state power sources for millimeter and submillimeter waves.
DTIC
Holography; Millimeter Waves; Conferences; Submillimeter Waves; Wave Fronts

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ACOUSTICS

Includes sound generation, transmission and attenuation. For noise pollution see 45 Environmental Pollution.

19990038386 Woods Hole Oceanographic Inst., Dept. of Applied Ocean Physics and Engineering, MA USA
High-Resolution, Three-Dimensional Measurements of Low-Frequency Sound Propagation in Shallow Water ***Final Report, 1 Mar. 1992 - 28 Feb. 1995***
Frisk, George V.; Becker, Kyle M.; Connor, Laurence N.; Doutt, James A.; Sellers, Cynthia J.; Jul. 23, 1998; 17p; In English
Contract(s)/Grant(s): N00014-92-J-1355
Report No.(s): AD-A361510; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

An overview is presented of the Model Mapping Experiment (MOMAX), in which both fixed and moving source configurations were used to transmit several pure tones in the frequency range 50 - 300 Hz in shallow water. The magnitudes and phases of these signals were recorded on several freely drifting buoys, each containing a hydrophone, GPS and acoustic navigation, and radio telemetry. High-resolution, three-dimensional measurements of the sound field were made out to ranges of 10 km and illustrate the influence of the laterally varying seabed in both the space and wavenumber domains. In addition, the phases of the mea-

sured signals show a remarkably high level of stability and regularity which can be exploited to make accurate estimates of the relative source/receiver speed from measurements of the time rate-of-change of the phase.
DTIC
Acoustic Measurement; Three Dimensional Models; Sound Propagation; High Resolution; Low Frequencies

19990040194 United Technologies Corp., Pratt and Whitney, East Hartford, CT USA
TFaNS Tone Fan Noise Design/Prediction System, Volume 1, System Description, CUP3D Technical Documentation and Manual for Code Developers ***Final Report***
Topol, David A., United Technologies Corp., USA; March 1999; 78p; In English
Contract(s)/Grant(s): NAS3-26618; RTOP 538-03-11
Report No.(s): NASA/CR-1999-208882/VOL1; NAS 1.26:208882/VOL1; E-11614; PWA-6420-101; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

TFaNS is the Tone Fan Noise Design/Prediction System developed by Pratt & Whitney under contract to NASA Lewis (presently NASA Glenn). The purpose of this system is to predict tone noise emanating from a fan stage including the effects of reflection and transmission by the rotor and stator and by the duct inlet and nozzle. These effects have been added to an existing annular duct/isolated stator noise prediction capability. TFaNS consists of: The codes that compute the acoustic properties (reflection and transmission coefficients) of the various elements and write them to files. Cup3D: Fan Noise Coupling Code that reads these files, solves the coupling problem, and outputs the desired noise predictions. AWAKEN: CFD/Measured Wake Postprocessor which reformats CFD wake predictions and/or measured wake data so it can be used by the system. This volume of the report provides technical background for TFaNS including the organization of the system and CUP3D technical documentation. This document also provides information for code developers who must write Acoustic Property Files in the CUP3D format. This report is divided into three volumes: Volume I: System Description, CUP3D Technical Documentation, and Manual for Code Developers; Volume II: User's Manual, TFaNS Vers. 1.4; Volume III: Evaluation of System Codes.
Author
Acoustic Properties; Aerodynamic Noise; Noise Prediction (Aircraft); Aircraft Noise; Rotor Blades (Turbomachinery); Stator Blades

19990040195 United Technologies Corp., Hamilton Standard Div., Windsor Locks, CT USA
Acoustic Scattering by Three-Dimensional Stators and Rotors Using the SOURCE3D Code, Volume 2, Scattering Plots ***Final Report***
Meyer, Harold D., United Technologies Corp., USA; March 1999; 658p; In English
Contract(s)/Grant(s): NAS3-26618; RTOP 538-03-11
Report No.(s): NASA/CR-1999-208887/VOL2; NAS 1.26:208887/VOL3; E-11623; PWA-6420-106; No Copyright; Avail: CASI; A99, Hardcopy; A06, Microfiche

This second volume of Acoustic Scattering by Three-Dimensional Stators and Rotors Using the SOURCE3D Code provides the scattering plots referenced by Volume 1. There are 648 plots. Half are for the 8750 rpm "high speed" operating condition and the other half are for the 7031 rpm "mid speed" operating condition.
Author
Plots; Graphs (Charts); Rotor Speed; Reflectance; Transmittance

19990040196 United Technologies Corp., Hamilton Standard Div., Windsor Locks, CT USA
Acoustic Scattering by Three-Dimensional Stators and Rotors Using the SOURCE3D Code, Volume 1, Analysis and Results
Meyer, Harold D., United Technologies Corp., USA; March 1999; 46p; In English
Contract(s)/Grant(s): NAS3-16618; RTOP 538-03-11
Report No.(s): NASA/CR-1999-208885; NAS 1.26:208885; E-11619; PWA-6420-105; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report provides a study of rotor and stator scattering using the SOURCE3D Rotor Wake/Stator Interaction Code. SOURCE3D is a quasi-three-dimensional computer program that uses three-dimensional acoustics and two-dimensional cascade load response theory to calculate rotor and stator modal reflection and transmission (scattering) coefficients. SOURCE3D is at the core of the TFaNS (Theoretical Fan Noise Design/Prediction System), developed for NASA, which provides complete fully coupled (inlet, rotor, stator, exit) noise solutions for turbofan engines. The reason for studying scattering is that we must first understand the behavior of the individual scattering coefficients provided by SOURCE3D, before eventually understanding the more complicated predictions from TFaNS. to study scattering, we have derived a large number of scattering curves for vane and blade

rows. The curves are plots of output wave power divided by input wave power (in dB units) versus vane/blade ratio. Some of these plots are shown in this report. All of the plots are provided in a separate volume. to assist in understanding the plots, formulas have been derived for special vane/blade ratios for which wavefronts are either parallel or normal to rotor or stator chords. From the plots, we have found that, for the most part, there was strong transmission and weak reflection over most of the vane/blade ratio range for the stator. For the rotor, there was little transmission loss.
Author
Acoustic Scattering; Aerodynamic Noise; Noise Prediction; Turbofans; Turbofan Engines; Rotor Blades (Turbomachinery); Stator Blades; Cascade Flow

19990040417 Washington State Univ., Dept. of Physics, Pullman, WA USA
Geometrical Aspects of Scattering and Physical Effects of Sound ***Annual Report, 1 Jun. 1997 - 31 May 1998***
Marston, Philip L.; Jun. 08, 1998; 18p; In English
Contract(s)/Grant(s): N00014-92-J-1600; N00014-97-1-0614
Report No.(s): AD-A361263; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Research is reported primarily in the following areas: (1) High-frequency enhancements of the backscattering of sound by tilted (empty and water-filled) blunt elastic cylindrical shells in water are calculated and observed. The leaky-wave contributions to backscattering were studied and were also studied for a solid stainless-steel cylinder. A different type of backscattering enhancement was also studied for penetrable cylinders (e.g. plastics) supporting low-velocity waves. This enhancement is associated with a caustic-merging transition which was also confirmed with an analogous light scattering experiment. (2) The coupling of oscillating magnetic fields to the torsional modes of a stainless steel spherical shell in water was investigated. (Sound radiated by the magnetically excited modes is detected and resonances are identified.) (3) Some predicted properties of helicoidal ultrasonic waves were confirmed using a novel PVDF transducer. These waves have an axial null and have potential applications in scattering and alignment and they carry orbital angular momentum. Other research summarized concerns; (4) acoustical-scattering analogs studied with light; and (5) the acoustical probing of dilute aqueous suspensions of particles using radiation pressure.
DTIC
Rayleigh Scattering; Acoustic Scattering; Metal-Water Reactions

19990040528 Dynacs Engineering Co., Inc., Cocoa Beach, FL USA
Rocket Noise Prediction Program
Margasahayam, Ravi, Dynacs Engineering Co., Inc., USA; Caimi, Raoul, Dynacs Engineering Co., Inc., USA; 1999; 8p; In English; 6th; Sound and Vibration (ICSV'6), 5-8 Jul. 1999, Copenhagen, Denmark
Contract(s)/Grant(s): NAS10-98001; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

A comprehensive, automated, and user-friendly software program was developed to predict the noise and ignition over-pressure environment generated during the launch of a rocket. The software allows for interactive modification of various parameters affecting the generated noise environment. Predictions can be made for different launch scenarios and a variety of vehicle and launch mount configurations. Moreover, predictions can be made for both near-field and far-field locations on the ground and any position on the vehicle. Multiple engine and fuel combinations can be addressed, and duct geometry can be incorporated efficiently. Applications in structural design are addressed.
Author
Noise Prediction; Ignition; Rocket Engines; Rocket Thrust; Liftoff (Launching); Software Engineering; Applications Programs (Computers)

19990040596 NASA Langley Research Center, Hampton, VA USA
Phenomenological Theory of the Translational Relaxation Times in Gases
Zuckerwar, Allan J., NASA Langley Research Center, USA; Journal of Acoustical Society of America; April 1999; Volume 104, No. 4, pp. 2210-2215; In English; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

The exact solution to the classical equations governing the translational dispersion and absorption of sound in a gas obscures its relaxational character because of its mathematical complexity. The approach taken here is to solve the secular equation by the method of Pade approximants, which even to the relatively low order R(sub 11) yields a remarkably close approximation to the exact solution over a wide range of frequency/pressure (f/P) ratios. As a result, translational relaxation can be formulated in terms of a conventional relaxation process with well-defined relaxation times, relaxation strength, collision numbers, additivity relations, etc. to extend the theory to high values of f/P ratio, a model is proposed to account for the noncontinuum behavior of the transport coefficients (viscosity and thermal conductivity) as the molecular mean free path approaches the acoustical enclosure dimensions. The theoretical dispersion and absorption show good agreement with measurements in argon over the classical and

transition regions of f/P, but a discrepancy appears at higher values of f/P, where collective propagating modes, assumed in the theory, give way to single-particle modes, prevailing in the experiments.
Author
Molecular Relaxation; Relaxation Time; Gas Flow; Sound Waves; Wave Propagation

19990040732 Air Force Research Lab., Wright-Patterson AFB, OH USA
Active Control of Weapon Bay Acoustics
Shaw, Leonard, Air Force Research Lab., USA; Aircraft Weapon System Compatibility and Integration; April 1999, pp. 22-1 - 22-10; In English; See also 19990040714; Copyright Waived; Avail: CASI; A02, Hardcopy; A03, Microfiche

To increase the range and payload of both existing and future aircraft, while maintaining or increasing mission survivability, weapons must be carried in low drag/low observable configurations. Existing external weapons carriage technology accounts for as much as 30% of total vehicle drag and prohibitive increases in radar signature. Internal weapons carriage solves signature issues, but substantially increases aircraft size while limiting weapon payloads to the size of weapon bays. New innovative and novel ways of both internal and external weapons carriage will be crucial to fighters of the next century. However, the new internal bays create a challenge to develop methods to suppress and control the internal flow induced acoustic environment in the weapons bay. The objective of the current wind tunnel test program was to define the baseline acoustic environment in a cavity and evaluate the effectiveness of active suppression concepts. The concepts consisted of leading edge oscillating flaps and leading edge pulsed fluidic actuation. Both concepts were evaluated for a range of parameters and the results indicate that either will successfully control the instabilities in the shear layer and thus suppress the flow induced acoustic environment in the cavity. The pulsed fluidic actuator was found to be more robust.
Author
Bays (Structural Units); Weapon Systems; Noise Reduction; Active Control; Internal Flow; Acoustics; Wind Tunnel Tests; Acoustic Excitation

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ATOMIC AND MOLECULAR PHYSICS

Includes atomic structure, electron properties, and molecular spectra.

19990039101 Air Force Inst. of Tech., School of Engineering, Wright-Patterson AFB, OH USA
Inelastic Scattering Matrix Elements for the Collision B(2P1/2) + H2(j) yields B(2P3/2) + H2(j')
Niday, Thomas A.; Mar. 1999; 113p; In English
Report No.(s): AD-A361413; AFIT/GAP/ENP/99M-06; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

Initial efforts to characterize the scattering dynamics of B + H2 focus on computing scattering matrix elements for the fine structure transition B (2P1/2) yields B (2P3/2) in collisions with H2, allowing for rotational excitation. Using a new application of the time dependent Channel Packet Method (CPM), reactant and product wave packets are prepared in the asymptotic limit on the B (2P1/2) and B (2P3/2) surfaces. They are propagated using the split operator method together with a unitary transformation between the diabatic and adiabatic representations. Scattering matrix elements are computed from the Fourier transform of the correlation function between the evolving wave packets. These computations directly support the Air Force Office of Scientific Research (AFOSR) Molecular Dynamics program and the Air Force Research Laboratory (AFRL) High Energy Density Matter (HEDM) program. In particular, the CPM is well suited to handle non-adiabatic molecular reaction dynamics on multiple potential energy surfaces, as encountered in the dynamics of a wide variety of molecular systems, including B + H2. Further motivation for investigating the specific dynamics of B + H2 stems from the potential application of solid molecular hydrogen, doped with boron atoms, as a high energy rocket propellant.
DTIC
Boron; Rocket Propellants; Hydrogen; High Energy Propellants; Heat Transfer; Doped Crystals; Collisions

19990039128 Department of Energy, Office of Energy Research, Washington, DC USA
Study of the chi(1) and chi(2) charmonium states formed in (anti p)p annihilations
Armstrong, T. A., Department of Energy, USA; Bettoni, D., Department of Energy, USA; Bharadwaj, V., Department of Energy, USA; Dec. 31, 1998; 35p; In English
Report No.(s): DE98-006387; DOE/ER/71019-T3-PT.5; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The authors report on a study of the P-3(1)(chi(1)) and P-3(2)(chi(2)) states of charmonium formed in antiproton-proton annihilations. An energy scan through the resonances, performed with a very narrow momentum-band beam of antiprotons intersecting a hydrogen jet target, enables them to perform very precise measurements of the mass and the total width of the two resonances. From their measurement of the quantity (Gamma yields (anti p)p) x BR(R yields J/(psi)(gamma)) x BR(J(psi) yields e(+)e(-)), using known branching ratios, the authors obtain: Gamma(chi(1) yields (anti p)p) = (69 +/- 13) eV; Gamma (chi(2) yields (anti p)p) = (180 +/- 31) eV.
NTIS
Annihilation Reactions; Charm (Particle Physics); Antiprotons; Protons; Mesons; Particle Production

19990039129 Department of Energy, Office of Energy Research, Washington, DC USA
Improved upper limits on B(K(L)(0) yields mu(e)) and B(K(L)(0) yields e(e)) and a new value for B(K(L)(0) yields mu(mu))
Molzon, W. R., Department of Energy, USA; Dec. 31, 1998; 4p; In English; High Energy Physics 25th, USA
Report No.(s): DE98-006391; DOE/ER/71019-T5-PT.3A; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The author gives recent results from E791 at BNL with improved upper limits on the branching fractions B(K(L)(0) yields mu(e)) and B(K(L)(0) yields e(e)) of 8.5 x 10(exp -11) and 11.6 x 10(exp -11) at 90% C.L. He also gives a preliminary result of a new measurement B(K(L)(0) yields mu(mu)) = 7.6 +/- 0.5(stat) +/- 0.4(syst) x 10(exp -9).
NTIS
Branching (Physics); Kaons; Muons; Electrons; Particle Decay

19990039134 Department of Energy, Office of Financial Management and Controller, Washington, DC USA
Time-resolved ion beam induced charge collection (TRIBICC) in microelectronics
Schoene, H., Department of Energy, USA; Walsh, D. S., Department of Energy, USA; Sexton, F. W., Department of Energy, USA; Doyle, B. L., Department of Energy, USA; Aurand, J. F., Department of Energy, USA; Dec. 31, 1998; 5p; In English; Nuclear and Space Radiation Effects, USA; Sponsored by Institute of Electrical and Electronics Engineers, USA
Report No.(s): DE98-007169; SAND-98-1702C; CONF-980705; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The entire current transient induced by single 12 MeV Carbon ions was measured at a 5 GHz analog bandwidth. A focused ion micro-beam was used to acquire multiple single ion transients at multiple locations of a single CMOS transistor. The current transients reveal clear and discernible contributions of drift and diffusive charge collection. Transients measured for drain and off- drain ion strikes compare well to 3D DAVINCI calculations. Estimates are presented for the drift assisted funneling charge collection depth.
NTIS
Ion Beams; Radiation Effects; Microbeams; Microelectronics

19990039193 Department of Energy, Office of Energy Research, Washington, DC USA
Strongly-interacting color-singlet exchange in (anti p)-p collisions at (radical)s = 1800 GeV
Thomas, T. L. T., Department of Energy, USA; Dec. 31, 1997; 194p; In English
Report No.(s): DE97-054502; DOE/CH/03000-T32; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Results are presented from an analysis of the particle multiplicity between high transverse energy jets in (anti p)-p collisions at (radical)s = 1,800 GeV. The data were collected using the D0 Detector at Fermi National Accelerator Laboratory. The authors observe an excess of events at low multiplicity which is consistent with strongly interacting color-singlet exchange. The fraction of events due to color-singlet exchange is measured as a function of the transverse energy and rapidity separation of the jets and is compared to several theoretical models for color-singlet exchange.
NTIS
Collisions; Mathematical Models; Protons; Antiprotons; Elementary Particle Interactions

19990039659 NASA Marshall Space Flight Center, Huntsville, AL USA
Studies of Light and Charge Produced by Alpha-Particles in High-Pressure Xenon
Bolotnikov, Aleksey, NASA Marshall Space Flight Center, USA; Ramsey, Brian, NASA Marshall Space Flight Center, USA; Nuclear Instruments and Methods in Physics Research A; 1999; ISSN 0168-9002; Volume 00, pp. 1-16; In English; Copyright; Avail: Department of Energy Information Bridge, Hardcopy, Microfiche

The results of measurements of scintillation light induced by alpha-particles in high-pressure Xe are presented. The ratio of N(sub ex)/N(sub i) and the intensity and time characteristics of the luminescence signal have been measured for different densities

up to 0.74 g/cc. The role and mechanisms of the electron-ion recombination in high-pressure gas have been investigated. The existence of clusters and self-trapped excitons above 0.6 g/cc has been observed and discussed. This work is a part of a development program of high-pressure Xe detectors for low-energy gamma rays.
Author
Scintillation; Alpha Particles; High Pressure; Xenon; Light Sources

19990040178 Alabama Univ., Lab. for Materials and Surface Science, Huntsville, AL USA
FNAS/LDEF Radiation Data Analysis ***Final Report***
Gregory, John, Alabama Univ., USA; October 1998; 22p; In English
Contract(s)/Grant(s): NAS8-38609; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The radioactive isotope Be-7 was discovered on the forward-facing side of the LDEF satellite in amounts far exceeding that expected from direct cosmic ray activation of the spacecraft material. This prompted an examination of the production of cosmogenic isotopes in the atmosphere and of the processes by which they may be transported to orbital altitudes and absorbed by a spacecraft. Be-7 is only one of several atmospheric cosmogenic isotopes which might be detectable at orbital altitudes and which might prove to be as useful as tracers of atmospheric circulation processes in the mesosphere and thermosphere, as they have been in the lower layers of the atmosphere.
Author
Beryllium Isotopes; Radioactive Isotopes; Cosmology; Atmospheric Chemistry

19990040210 Rutherford Appleton Lab., Chilton, UK
A Dynamical Mechanism for Quark Mixing and Neutrino Oscillations
Bordes, Jose, Valencia Univ., Spain; Chan, Hong-Mo, Rutherford Appleton Lab., UK; Tsou, Sheung Tsun, Oxford Univ., UK; Jan. 29, 1999; ISSN 1358-6254; In English
Contract(s)/Grant(s): CYCIT96-1718; PB97-1261; GV98-1-80
Report No.(s): RAL-TR-1999-013; Copyright; Avail: Issuing Activity (CDRL, Rutherford Appleton Lab., Chilton, Didcot, Oxfordshire OX11 0QX, UK), Hardcopy, Microfiche

We show that assuming fermion generations to be given by a gauge symmetry plus a certain Higgs mechanism for its breaking, the known empirical features of quark and lepton mixing can be largely explained, including in particular the fact that the mixing (CKM) matrix element U(sub mu3) responsible for the muon anomaly in atmospheric neutrinos is near maximal and much larger than their quark counterparts V(sub cb) and V(sub ts), while the corner elements for both quarks (V(sub ub), V(sub td)) and leptons (U(sub e3)) are all very small. The mechanism also gives automatically a hierarchical fermion mass spectrum which is intimately related to the mixing pattern.
Author
Fermions; Broken Symmetry; Gauge Theory

19990040227 Department of Energy, Washington, DC USA
Linear dichroism and resonant photoemission in Gd 011
Mishra, S. R., Department of Energy, USA; Cummins, T. R., Department of Energy, USA; Gammon, W. J., Department of Energy, USA; vanderLaan, G., Department of Energy, USA; Goodman, K. W., Department of Energy, USA; May 13, 1998; 9p; In English; Magnetic Multilayer, USA
Report No.(s): DE98-058832; UCRL-JC-130796; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Magnetic Linear Dichroism in Angular Distributions (MLDAD) from Photoelectron Emission was used to probe the nature of Resonant Photoemission. Gd 5p and Gd 4f emission were investigated. Using novel theoretical simulations, we were able to show that temporal matching is a requirement for 'True' Resonant Photoemission, where the Resonant Photoemission retains the characteristics of Photoelectron Emission.
NTIS
Gadolinium; Photoelectric Emission; Dichroism

19990040293 California Univ., Lawrence Berkeley Lab., Berkeley, CA USA
Radiation Transmission Properties of In-Situ Materials
Heilbronn, Lawrence, California Univ., Lawrence Berkeley Lab., USA; Townsend, Larry, Tennessee Univ., USA; NASA Microgravity Materials Science Conference; February 1999, pp. 307-311; In English; See also 19990040241; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

In order to accurately determine the radiation risk to astronauts from Galactic Cosmic Rays (GCR) and Solar Particle Events (SPE), the nature of the secondary radiation field created by the fragmentation of GCR and SPE in shielding and tissue must be understood. Due to their high penetrabilities, neutrons are an important component of the secondary radiation field, especially for astronauts protected by thick shielding on lunar or Martian bases. Because of their relatively short lifetimes, free neutrons are not present in the primary GCR. The predominant source of neutrons, then, is interactions of GCR and SPE in shielding materials. These interactions span the full range of GCR ions (protons, helium, and HZE) and GCR energies (100 MeV/nucleon and up); hence neutrons are produced from an enormous set of varied and different interactions. Some studies have been conducted at ground-based accelerator facilities in regards to the production of neutrons from GCR-like interactions, but because accelerator resources are limited and because neutron experiments require a large amount of the time available at those accelerators, the best approach to the problem of determining the amount of neutron radiation behind shielding is through a calculational approach. New and innovative materials involving the use of local regolith are being developed and studied for their usefulness in lunar and Martian base design. One important design criterion is the ability of those materials to shield human personnel from the radiation environment in which such bases will exist. Because neutrons will be a significant component of the radiation environment inside those bases, it is critical that computer models be developed which can accurately predict the production of neutrons from GCR and SPE interactions with in-situ materials. The primary thrust of the research program described here is to develop an accurate neutron production model, with an emphasis on neutron production from composites comprised of in-situ materials. Because models used to calculate neutron production behind thick shields will need cross-section and thick-target production data for verification of model input and output, emphasis will also be placed on completing analysis of existing neutron-production data and compiling a set of experimental neutron production data which is relevant to model development. The research program described here is a four-year program started in 1998. A general description of the theory program and experimental-data-base development program follows, along with expected goals and milestones of the overall program. In addition, some preliminary results from analysis of experimental data is presented.

Derived from text

Galactic Cosmic Rays; Neutrons; Radiation Distribution; Radiation Shielding; Solar Corpuscular Radiation; Space Habitats; Models; Computerized Simulation

19990040534 Department of Energy, Office of Energy Research, Washington, DC USA

Hyperon particle physics at JHF

Mischke, R. E., Department of Energy, USA; Dec. 31, 1998; 4p; In English

Report No.(s): DE99-001070; LA-UR-98-2112; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

This paper discusses the possibility of a program in hyperon decay physics at the Japan Hadron Facility. The study of hyperon decays has a history of over 40 years of experimental results. However, many of the earliest results are still the best available and there are many gaps in the data. The static properties of hyperons (masses, magnetic moments) are in relatively good shape. Much work remains to be done on the decays of hyperons and hyperon resonances. There are current experiments at the major accelerator facilities that address various hyperon decays, but no comprehensive program. This presents an excellent opportunity for such a program to be considered at JHF. The high- intensity beams of pi, K, and p beams will allow experiments to be designed that optimize the properties of the hyperons being studied. It is possible to envision experiments with samples of 10(exp 9) hyperon decays in 10(exp 7) sec runs.

NTIS

Hyperons; Particle Decay; Hadrons; Weak Energy Interactions

19990040573 Department of Energy, Office of Energy Research, Washington, DC USA

Can BNL-Style Studies of K Yields pi.nu.bar-nu be Pushed at the FEMC

Littenberg, L., Department of Energy, USA; Nov. 30, 1997; 11p; In English; Front end of the Muon Colliders, USA

Report No.(s): DE98-002805; BNL-65194; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Techniques developed for studying K(sup +) yields pi(+).nu.bar-nu and K(sub L) yields pi(0).nu.bar-nu at the Brookhaven National Laboratory. Alternating Gradient Synchrotron are briefly described. The applicability of these approaches at the front end of the First Muon Collider is assessed.

NTIS

Investigation; Research and Development; Methodology; Kaons

19990040578 Department of Energy, Office of Energy Research, Washington, DC USA

Charm Quark's Mass

Kroufield, A. S., Department of Energy, USA; Oct. 31, 1997; 5p; In English; 15th; Lattice Field Theory (Lattice-15), USA

Report No.(s): DE98-050066; FNAL/C-97/326-T; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The charm quark's mass is determined from Monte Carlo calculations of the (anti c)c spectrum. The main sources of uncertainty are perturbation theory (for conversion to (ovr MS)), the continuum limit extrapolation, Monte Carlo statistics, and the effects of quenching. The (preliminary) result for the (ovr MS) mass is (anti m)(sub ch)(m(sub ch)) = 1.33 +/-0.08 GeV.

NTIS

Quarks; Charm (Particle Physics); Mass

19990040593 NASA Lewis Research Center, Cleveland, OH USA

Simple Device for Monitoring Secondary Electron Emission of Materials in the Pulse Mode

Krainsky, Isay L., NASA Lewis Research Center, USA; Lesny, Gary G., NASA Lewis Research Center, USA; 1997; 9p; In English; No Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

A simple device for simultaneously measuring the Secondary Electron Emission coefficient sigma and the primary current in the pulse mode has been built. It allows convenient monitoring of these parameters for either conductive or insulating materials. Author

Secondary Emission; Measuring Instruments; Electric Pulses; Pulse Duration

19990040676 Oak Ridge National Lab., TN USA

Uncooled IR photon detection using MEMS microstructures

Datskos, P. G., Oak Ridge National Lab., USA; Rajic, S., Oak Ridge National Lab., USA; Aug. 31, 1998; 7p; In English; IRIS meeting on materials and detectors; Sponsored by Department of Energy, USA

Report No.(s): DE99-000236; ORNL/CP-99567; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Generation of free carriers in a semiconductor gives rise to mechanical stress. Photo-induced stress phenomena in Microelectromechanical Systems (MEMS) microstructures can be used in the room temperature detection of infrared photons. Choice of the appropriate semiconductor material for the MEMS microstructures determines the cutoff wavelength of the uncooled infrared photon detector. The authors have measured the deflection of silicon and indium antimonide microstructures resulting from a photo-induced stress. The excess charge carriers responsible for the photo-induced stress were produced via photon irradiation from both a diode laser and a black body source. In the case of Si, the photo-induced stress is of opposite direction and about four times larger than the thermal stress. For indium antimonide the direction of stress is the same as due to thermal effects. The photo-induced stress can be distinguished from the thermal stress based on the cut-off wavelength, response speed, and perhaps the direction of the microstructure deflection.

NTIS

Microelectromechanical Systems; Infrared Detectors; Photons; Microstructure; Detection

19990040696 Los Alamos National Lab., NM USA

Energetic neutral atom imaging with the Polar CEPPAD/IPS instrument: Initial forward modeling results

Henderson, M. G.; Reeves, G. D.; Moore, K. R.; Spence, H. E.; Jorgensen, A. M.; Dec. 31, 1997; 8p; In English; Paros ISTP

Report No.(s): DE99-000750; LA-UR-98-2147; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Although the primary function of the CEP-PAD/IPS instrument on Polar is the measurement of energetic ions in-situ, it has also proven to be a very capable Energetic neutral Atom (ENA) imager. Raw ENA images are currently being constructed on a routine basis with a temporal resolution of minutes during both active and quiet times. However, while analyses of these images by themselves provide much information on the spatial distribution and dynamics of the energetic ion population in the ring current, detailed modeling is required to extract the actual ion distributions. In this paper, the authors present the initial results of forward modeling an IPS ENA image obtained during a small geo-magnetic storm on June 9, 1997. The equatorial ion distribution inferred with this technique reproduces the expected large noon/midnight and dawn/dusk asymmetries. The limitations of the model are discussed and a number of modifications to the basic forward modeling technique are proposed which should significantly improve its performance in future studies.

NTIS

Imaging Techniques; Neutral Atoms; Neutral Particles; Mathematical Models

19990040765 Sandia National Labs., Albuquerque, NM USA

Radiation damage measurements in room temperature semiconductor radiation detectors

Franks, L. A.; Olsen, R. W.; James, R. B.; Brunett, B. A.; Walsh, D. S.; Dec. 31, 1998; 11p; In English; 6th; Nuclear microprobe technology and applications

Report No.(s): DE99-001061; SAND-98-2192C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The literature of radiation damage measurements on cadmium zinc telluride (CZT), cadmium telluride (CT), and mercuric iodide (HgI2) is reviewed and in the case of CZT supplemented by new alpha particle data. CZT strip detectors exposed to intermediate energy (1.3 MeV) proton fluences exhibit increased interstrip leakage after 10(exp 10) p/sq cm and significant bulk leakage after 10(exp 12) p/sq cm. CZT exposed to 200 MeV protons shows a two-fold loss in energy resolution after a fluence of 5 x 10 (exp 9) p/sq cm in thick (3 mm) planar devices but little effect in 2 mm devices. No energy resolution effects were noted from moderated fission spectrum of neutrons after fluences up to 10(exp 10) n/sq cm, although activation was evident. Exposures of CZT to 5 MeV alpha particle at fluences up to 1.5 x 10(exp 10) alpha/sq cm produced a near linear decrease in peak position with fluence and increases in FWHM beginning at about 7.5 x 10(exp 9) alpha /sq cm. CT detectors show resolution losses after fluences of 3 x 10(exp 9) p/sq cm at 33 MeV for chlorine-doped detectors. Indium doped material may be more resistant. Neutron exposures (8 MeV) caused resolution losses after fluences of 2 x 10(exp 10) n/sq cm. Mercuric iodide has been studied with intermediate energy protons (10 to 33 MeV) at fluences up to 10(exp 12) p/sq cm and with 1.5 GeV protons at fluences up to 1.2 x 10(exp 8) p/sq cm. Neutron exposures at 8 MeV have been reported at fluences up to 10(exp 15) n/sq cm. No radiation damage was reported under these irradiation conditions.

NTIS

Room Temperature; Radiation Detectors; Radiation Damage; Semiconductors (Materials)

19990040783 Sandia National Labs., Albuquerque, NM USA

Total ionizing dose effects on MOS and bipolar devices in the natural space radiation environment

Fleetwood, D. M.; Dec. 31, 1998; 8p; In English

Report No.(s): DE99-000996; SAND-98-2040C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Mechanisms that control the response of MOS and bipolar devices to ionizing radiation in the natural space environment are briefly reviewed. Standard tests based on room-temperature irradiation and elevated temperature annealing are described for MOS devices to bound the effects of oxide and interface-trap charge in space. For bipolar devices that exhibit enhanced low-dose-rate sensitivity, a standard test equivalent to that developed for MOS devices is not available. However, screening techniques based on room temperature and/or elevated temperature irradiations are described which can minimize the risk to spacecraft and satellite electronics from this phenomenon.

NTIS

Ionizing Radiation; Bipolarity; Aerospace Environments; Radiation Dosage; Semiconductor Devices

19990040823 Georgia Inst. of Tech., School of Physics, Atlanta, GA USA

Collision Dynamics With Stretched Atoms ***Final Report, 1 Aug. 1996 - 30 Nov. 1998***

Flannery, M. R.; Jan. 21, 1999; 28p; In English

Contract(s)/Grant(s): F49620-96-1-0142

Report No.(s): AD-A361186; AFRL-SR-BL-TR-99-0093; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This Final Report on Grant AFOSR: F49620-96-1-0142 documents: (a) the research accomplished (b) the papers published (c) the invited papers presented at professional scientific conferences and (d) the awards received during the research period August. 1996 - November. 1998. The research entitled ”Collision Dynamics with Stretched Atoms” deals with stretched atoms in collisions with other species (electrons. ions and atoms) and with recombination processes (electron -ion) which produce stretched atoms.

DTIC

Atomic Collisions; Electrons; Collisions

19990040833 Air Force Inst. of Tech., School of Engineering, Wright-Patterson AFB, OH USA

Space Charge Structure of a Glow Discharge in the Presence of a Longitudinal Inhomogeneity

Tersigni, Frank A.; Mar. 1999; 77p; In English

Report No.(s): AD-A361406; AFIT/GAP/ENP/99M-14; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

A survey of space charge structures arising due to inhomogeneities in glow discharges was conducted. Space charge structures associated with tube geometries, the cathode sheath, striations, and shockwaves were examined. Space charge effects on the Electron Energy Distribution Function (EEDF) were explored for a geometric inhomogeneity using an approximate nonlocal solution to the one dimensional Boltzmann equation after Godyak. The approximate solution partially captured qualitative aspects of space charge effects on the EEDF. Simplification of collisional effects and adaptation of an approximate electric field restricted quantitative comparisons with experimental data. It is recommended that any future analysis of space charge effects on the EEDF should

include energy losses due to elastic collisions, electron-electron collisions and a two dimensional representation of the electric field.
DTIC
Glow Discharges; Space Charge; Electron Scattering; Shock Waves; Elastic Scattering

19990040868 Department of Energy, Washington, DC USA
Development of a high intensity EBIT for basic and applied science/011
Marrs, R. E.; Feb. 05, 1998; 6p; In English
Report No.(s): DE98-058784; UCRL-ID-129832; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The electron-beam ion trap (EBIT) is a device for producing and studying cold, very highly charged ions of any element, up to a fully ionized U(sup 92+) . These highly charged ions occur in hot plasmas and therefore play important roles in nuclear weapons, controlled fusion, and astrophysical phenomena. The remarkable interaction of these ions with surfaces may lead to technological applications. The highly charged ions can either be studied inside the EBIT itself with measurements of their x-ray emission spectra, or the ions can be extracted from the EBIT in order to study their interaction with solid material. Both types of measurements are being pursued vigorously with the two existing low-intensity EBITs at LLNL and with similar EBITs that have been built at six other laboratories around the world since the EBIT was first developed at LLNL 10 years ago. However, all existing EBITs have approximately the same intensity as the original LLNL EBIT; that is, they all produce about the same number of very-highly-charged ions (roughly 2 x 10(exp 6) per second) and the same number of x-ray photons (roughly 10(exp 7) per second). The goal of the High-Intensity-EBIT project is to increase the x-ray emission per centimeter of length along the electron beam by a factor of 100 and to increase the ion output by a factor of 1000. This dramatic increase in intensity will enable the next generation of basic and applied experimental research in the structure of highly charged ions. For example, the precision of EBIT x-ray measurements of atomic energy levels- which is now limited by count rate-can be improved by an order of magnitude, and new applications in surface science, nanotechnology, and microscopy will be possible with the expected intense ion beams. When the high ion output is combined with the demonstrated low emittance of EBIT ions, we will have a high-brightness source of highly charged ions that can be focused to submicrometer spots. One example of a measurement that will benefit from increased x-ray intensity is our study of the binding energy of high-Z heliumlike ions. The small ''two-electron'' contribution to this binding energy is a fundamental aspect of atomic structure. It arises from the small forces that the two electrons exert on each other in the presence of the much larger force from the atomic nucleus. Our existing EBIT measurements are sensitive to the so-called ''second order'' contribution to the two-electron binding energy, but with the High-Intensity EBIT we can probe an even more subtle effect: the screening by one electron of the quantum electrodynamic (QED) energy contribution from the other electron.
NTIS
Electron Beams; Ion Beams; Ion Traps (Instrumentation)

19990040944 Stanford Linear Accelerator Center, Stanford, CA USA
Heavy quark mass effects and improved tests of the flavor independence of strong interactions
Burrows, P. N.; Aug. 31, 1998; 17p; In English; 29th; High-energy physics, 1998
Report No.(s): DE98-059267; SLAC-PUB-7914; OUNP-98-06; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

A review is given of latest results on tests of the flavor independence of strong interactions. Heavy quark mass effects are evident in the data and are now taken into account at next-to-leading order in Quantum Chromodynamics (QCD) perturbation theory. The strong-coupling ratios alpha(sub s)(sup b)/alpha(sub s)(sup uds) and alpha (sub s)(sup c)/alpha(sub s)(sup uds) are found to be consistent with unity. Determinations of the b-quark mass m(sub b) (M(sub Z)) are discussed.
NTIS
Quarks; Particle Mass; Strong Interactions (Field Theory)

19990040945 Stanford Linear Accelerator Center, Stanford, CA USA
Inclusive search for b to sg
Jul. 31, 1998; 22p; In English; 29th; High-energy physics
Report No.(s): DE98-059262; SLAC-PUB-7896; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The authors describe an inclusive search for flavor changing neutral current decays of the type b to s gluon in the SLC Large Detector (SLD) experiment. Models of b to sg indicate that the production of high momentum kaons is enhanced over background from standard B decays. If the branching ratio for b to sg is approximately 10%, then such an enhancement should have a good

signal to background ratio. The analysis makes use of the particle identification and high precision vertexing capabilities of SLD to search for such an enhancement. The data sample consists of 300 K hadronic Z(sup 0) decays collected between 1993 and 1997.
NTIS
Quarks; Neutral Currents; Particle Decay; Gluons

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NUCLEAR AND HIGH-ENERGY PHYSICS

Includes elementary and nuclear particles; and reactor theory. For space radiation see 93 Space Radiation.

19990038367 Department of Energy, Office of Energy Research, Washington, DC USA
Long-Pulse Spallation Source at Los Alamos: Facility description and preliminary neutronic performance for cold neutrons
Russell, G. J., Department of Energy, USA; Weinacht, D. J., Department of Energy, USA; Pitcher, E. J., Department of Energy, USA; Ferguson, P. D., Department of Energy, USA; Mar. 31, 1998; 14p; In English, USA; Sponsored by Minerals, Metals and Materials Society, USA
Report No.(s): DE98-004681; LA-UR-97-5037; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The Los Alamos National Laboratory has discussed installing a new 1-MW spallation neutron target station in an existing building at the end of its 800- MeV proton linear accelerator. Because the accelerator provides pulses of protons each about 1 msec in duration, the new source would be a Long Pulse Spallation Source (LPSS). The facility would employ vertical extraction of moderators and reflectors, and horizontal extraction of the spallation target. An LPSS uses coupled moderators rather than decoupled ones. There are potential gains of about a factor of 6 to 7 in the time-averaged neutron brightness for cold-neutron production from a coupled liquid H2 moderator compared to a decoupled one. However, these gains come at the expense of putting 'tails' on the neutron pulses. The particulars of the neutron pulses from a moderator (e.g., energy-dependent rise times, peak intensities, pulse widths, and decay constant(s) of the tails) are crucial parameters for designing instruments and estimating their performance at an LPSS. Tungsten is the reference target material. Inconel 718 is the reference target canister and proton beam window material, with Al-6061 being the choice for the liquid H2 moderator canister and vacuum container. A 1-MW LPSS would have world-class neutronic performance. The authors describe the proposed Los Alamos LPSS facility, and show that, for cold neutrons, the calculated time-averaged neutronic performance of a liquid H2 moderator at the 1-MW LPSS is equivalent to about 1/4th the calculated neutronic performance of the best liquid D2 moderator at the Institute Laue-Langevin reactor. They show that the time- averaged moderator neutronic brightness increases as the size of the moderator gets smaller.
NTIS
Spallation; Neutrons; Cold Neutrons; Neutron Sources; Pulses

19990039136 Department of Energy, Assistant Secretary for Nuclear Energy, Washington, DC USA
Coupling 2-D cylindrical and 3-D x-y-z transport computations
Abu-Shumays, I. K., Department of Energy, USA; Yehnert, C. E., Department of Energy, USA; Pitcairn, T. N., Department of Energy, USA; Jun. 30, 1998; 15p; In English; Physics of Nuclear Science and Technology, USA
Report No.(s): DE98-007217; WAPD-T-3086; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

This paper describes a new two-dimensional (2-D) cylindrical geometry to three-dimensional (3-D) rectangular x-y-z splice option for multi-dimensional discrete ordinates solutions to the neutron (photon) transport equation. Of particular interest are the simple transformations developed and applied in order to carry out the required spatial and angular interpolations. The spatial interpolations are linear and equivalent to those applied elsewhere. The angular interpolations are based on a high order spherical harmonics representation of the angular flux. Advantages of the current angular interpolations over previous work are discussed. An application to an intricate streaming problem is provided to demonstrate the advantages of the new method for efficient and accurate prediction of particle behavior in complex geometries.
NTIS
Transport Properties; Cylindrical Bodies; Neutrons; Transformations (Mathematics)

19990039550 Air Force Inst. of Tech., School of Engineering, Wright-Patterson AFB, OH USA
Characterization of the Double Scatter Spectrum in Multiplexed Compton Scatter Tomography
Gerts, David W.; Mar. 1999; 109p; In English
Report No.(s): AD-A361457; AFIT/GAP/ENP/99M-03; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

The Multiplexed Compton Scatter Tomograph (MCST) uses single back-scattered photons to image electron density in aluminum. A source of error in this imaging technique is the presence of multiple scatters. This thesis studies the double scatter spectrum as an approximation of the multiple scatter spectrum. A deterministic code called Monte Carlo Double Scatter (MOCADS) was developed to investigate the double scatter spectrum. The code includes calculations of the Rayleigh scatter, Compton scatter, Doppler broadening effects of the spectrum, and polarization effects following the Compton scatter. The Doppler broadening portion of the code was validated by a deterministic code called Scatgram. The mechanics of double scatter were validated by a Monte Carlo transport code. and all included features in the code were validated by a laboratory experiment. The MOCADS code was used to simulate an experiment where a void was present in the sample and compared to a solid sample. The simulation showed that the shape of the double scatter spectrum did not depend of the presence of the void. Another simulation examined the effects of polarization and Doppler broadening. These two effects were shown to significantly influence the shape of the spectrum. Finally, a laboratory experiment was examined where the single scatter estimate was improved by the removal of the double scatter spectrum from the total spectrum.
DTIC
Electron Density (Concentration); Compton Effect; Imaging Techniques

19990039595 Department of Energy, Office of Energy Research, Washington, DC USA
Alternative window upon the GSI sharp lepton problem
Griffin, J. J., Department of Energy, USA; Oct. 31, 1997; 15p; In English; Physics Since Parity Symmetry Breaking, USA
Report No.(s): DE98-000431; DOE/ER/40762-134; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Two major heavy ion studies of the GSI e(+)e(-))-Puzzle have ended in stalemate: APEX reports no evidence, but its data show a peak near 800 keV. EPOS/II cannot reproduce its own results,and leans towards random fluctuations as the explanation of sharp pair lines. (But one EPOS/II report shows evidence for a peak at an EPOS/I line energy, 610 keV, and under selection conditions the same as EPOSII's.) It is clear that these latest heavy ion studies, designed to settle once and for all the question of sharp pairs, have failed to fulfill that goal. Attention must now turn towards the sharp electron lines reported by Sakai et al. and others in collisions of few MeV beta decay positrons on U and Th atoms. In the Q(0) Scenario of the Sharp Lepton Problem these arise from the same source as the GSI pairs. Verification of Sakai's 100 mb cross section for such sharp electrons in collisions of few MeV electrons (or positrons) upon U or Th atoms would confirm this new experimental window upon the Sharp Lepton Problem. These relatively simple experiments, which are both inexpensive and reproducible (as their heavy ion counterparts are not), promise a less ponderous pace for the study of these questions. On the other hand, they require a challenging combination of proficiencies to measure a nuclear sized cross section in an atomic physics environment. The authors review briefly the diverse history (and especially the most recent developments) of the Sharp Lepton Problem, and outline how the Quadronium Scenario provides it with a unifying conceptual framework. That discussion points clearly towards the experimental study of sharp leptons and sharp pairs from few MeV (lepton+ATOM) and (photon+ATOM) processes as the appropriate next step towards either verifying the earlier results or precluding them.
NTIS
Leptons; Atomic Physics; Quantum Electrodynamics

19990040232 Department of Energy, Office of Energy Research, Washington, DC USA
Confining N = 1 supersymmetric gauge theories: A review
Csaki, C., Department of Energy, USA; Aug. 31, 1998; 12p; In English; Continuous Advances in QCD3rd, USA
Report No.(s): DE98-059385; LBNL-42126; UCB-PTH-98/39; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The authors give a classification and overview of the confining N = 1 supersymmetric gauge theories. For simplicity they consider only theories based on simple gauge groups and no tree-level superpotential. Classification of these theories can be done according to whether or not there is a superpotential generated for the confined degrees of freedom. The theories with the superpotential include s-confining theories and also theories where the gauge fields participate in the confining spectrum, while theories with no superpotential include theories with a quantum deformed moduli space and theories with an affine moduli space.
NTIS
Supersymmetry; Quantum Chromodynamics; Gauge Theory

19990040572 Department of Energy, Office of Energy Research, Washington, DC USA
Higgs Resonance Studies at the First Muon Collider
Kamal, B., Department of Energy, USA; Marciano, W. J., Department of Energy, USA; Parsa, Z., Department of Energy, USA; Dec. 31, 1997; 9p; In English; Front End of the Muon Colliders, USA

Report No.(s): DE98-002806; BNL-65193; CAP-194-MUON-97C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Higgs resonance signals and backgrounds at the First Muon Collider are discussed. Effects due to beam polarization and background angular distributions (forward-backward charge asymmetries) are examined. The utility of those features for improving precision measurements and narrow resonance 'discovery' scans is described.

NTIS

Higgs Bosons; Muons; Particle Interactions; Resonance

19990040777 Pennsylvania Univ., Philadelphia, PA USA

Super conductor Supercollider front end electronics development; ring imaging Cerenkov studies; and warm liquid calorimetry ***Final Report***

Dec. 31, 1998; 4p; In English

Report No.(s): DE99-001052; DOE/ER/40680-2; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The University of Pennsylvania group that was involved in SDC was responsible, jointly with the KEK Laboratory in Japan, for the design and production of the readout electronics for the SDC straw tube tracker (a $12 million electronics effort). Their responsibilities included major contributions to the overall conceptual design, oversight of all the contributions from North America and direct responsibility for the HV/ASD assembly, the amplifier-shaper-discriminator chip, and HV distribution on the detector (the responsibility for the latter being shared with Colorado).

NTIS

Superconducting Super Collider; Cerenkov Counters; Cerenkov Radiation; Imaging Techniques; Heat Measurement

19990040946 Stanford Linear Accelerator Center, Stanford, CA USA

Measurement of R(sub c) using the SLD detector

Jul. 17, 1998; 11p; In English; 29th; High-energy physics

Report No.(s): DE98-059252; SLAC-PUB-7880; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The authors report a new measurement of R(sub c) using data obtained with the SLD detector in 1993--1997. This measurement uses a double tag technique, where the selection of a c hemisphere is based on the reconstructed mass of the charm hadron decay vertex. The method uses the 3D vertexing capabilities of SLD's CCD vertex detectors and the small and stable SLC beams to obtain a high c-tagging efficiency and purity of 15% and 69%, respectively. They obtain a preliminary 93--97 result of R(sub c) = 0.1794 +/- 0.0085(sub stat.) +/- 0.0061(sub syst.).

NTIS

Detectors; Quarks

19990040947 Stanford Linear Accelerator Center, Stanford, CA USA

Improved inclusive measurement of A(sub c) using the SLD detector

Jul. 20, 1998; 12p; In English; High-energy physics, 1998

Report No.(s): DE98-059251; SLAC-PUB-7879; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The authors report a new measurement of A(sub c) using data obtained by SLC Large Detector (SLD) in 1993-1997. This measurement uses a vertex tag technique, where the selection of a c hemisphere is based on the reconstructed mass of the charm hadron decay vertex. The method uses the 3D vertexting capabilities of SLD's CCD vertex detector and the small and stable SLC beams to obtain a high c-event tagging efficiency and purity of 28% and 81%, respectively. Charged kaons identified by the CRID detector and the charge of the reconstructed vertex provide an efficient quark-antiquark tag. They obtain a preliminary result of A(sub c) = 0.650 +/- 0.041 +/- 0.033.

NTIS

Measurement; Detectors

19990041037 Oak Ridge National Lab., TN USA

Modeling and analysis of AGS thermal shock experiments

Taleyarkhan, R. P.; Kim, S. H.; Haines, J. R.; Dec. 31, 1998; 7p; In English

Report No.(s): DE99-000385; ORNL/CP-99081; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

An overview is provided on modeling and analysis of thermal shock experiments conducted with high-energy, short-pulse energy deposition in a mercury filled container in the Alternating Gradient Synchrotron (AGS) facility at Brookhaven National Laboratory (BNL). The simulation framework utilized along with results of simulations for pressure and strain profiles are presented. While the magnitude of peak strain predictions versus data are in reasonable agreement, the temporal variations were found

to differ significantly in selected cases, indicating lack of modeling of certain physical phenomena or due to uncertainties in the experimental data gathering techniques. Key thermal-shock related issues and uncertainties are highlighted.
NTIS
Thermal Shock; Targets; Mathematical Models; Numerical Analysis; Experimentation; Simulation

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OPTICS

Includes light phenomena; and optical devices. For lasers see 36 Lasers and Masers.

19990038387 New Span Opto-Technology, Inc., Miami, FL USA
High Density Optical Interconnection Based on Free Space Non-Diffracting Beams ***Final Report, 20 Aug. 1998 - 19 Feb. 1999***
Wang, Michael R.; Mar. 29, 1999; 49p; In English; Prepared in cooperation with Miami Univ., Miami, FL.
Contract(s)/Grant(s): DASG60-98-M-0156
Report No.(s): AD-A361509; NSOT-0201REP-BMDO; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Optical interconnects are required for high speed opto-electronic packaged computing systems for fast access to large intelligent database and for fast image data processing. However, existing free space optical interconnection suffers from diffraction limitation of interconnect line density and requires many large and sophisticated beam collimation, focusing, and interconnect reconfiguration elements. It is preferred to have small interconnection beams and with large interconnection distance. Such contradictory requirement is not possible by conventional Gaussian optical beams propagating in free space. It is however possible using non-diffracting beams since the diffraction contribution of the non-diffracting beam permits the beam to propagate in free space for a substantially large distance without significant beam size broadening. In this Phase I SBIR program New Span Opto-Technology Inc. in collaboration with University of Miami demonstrated the feasibility of high-density optical interconnection based on free space non-diffracting beams. Using a diffractive beam shaper we achieved 87% efficiency. We also achieved 100 micron beam propagation of 40 cm range.
DTIC
Optical Interconnects; Light Beams; Diffraction; Flux Density

19990039541 NASA Marshall Space Flight Center, Huntsville, AL USA
Advanced X-ray Astrophysics Facility (AXAF): Calibration Overview
ODell, S. L., NASA Marshall Space Flight Center, USA; Weisskopf, M. C., NASA Marshall Space Flight Center, USA; Proceedings of the SPIE Reprint; 1998; Volume 3444, pp. 1-18; In English; X-Ray Optics, Instruments, and Missions, 19-22 Jul. 1998, San Diego, CA, USA; Sponsored by International Society for Optical Engineering, USA; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

The Advanced X-ray Astrophysics Facility (AXAF), the x-ray component of NASA's Great Observatories, will launch in 1999. As integration and testing of the flight system are concluding, analysis of the ground calibration data continues. This analysis verifies AXAF's unique capabilities for high-resolution imaging and for high-resolution dispersive spectroscopy. However, it finds un- expectedly high (approx. 10%) residuals between the data and the model for effective area of the AXAF optics. Reconciling the physical model with the data, to an accuracy of a few percent, remains a goal of the analysis and interpretation of the calibration data.
Author
X Ray Astrophysics Facility; Calibrating; Data Acquisition; Ground Tests; X Ray Spectroscopy

19990039604 Department of Energy, Office of Energy Research, Washington, DC USA
Extreme ultraviolet interferometry
Goldberg, K. A., Department of Energy, USA; Dec. 31, 1997; 288p; In English
Report No.(s): DE98-052889; LBNL-41283; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Extreme Ultraviolet (EUV) lithography is a promising and viable candidate for circuit fabrication with 0.1 micron critical dimension and smaller. This dissertation discusses the development and successful implementation of high-accuracy EUV interferometric techniques. Proof-of-principle experiments with a prototype EUV point-diffraction interferometer for the measurement of Fresnel zoneplate lenses first demonstrated sub-wavelength EUV interferometric capability. These experiments spurred the development of the superior phase-shifting point-diffraction interferometer (PS/PDI), which has been implemented for the testing of an all-reflective lithographic-quality EUV optical system. Both systems rely on pinhole diffraction to produce spherical

reference wavefronts in a common-path geometry. Complementary to the experimental research, several areas of theoretical investigation related to the novel PS/PDI system are presented. First-principles electromagnetic field simulations of pinhole diffraction are conducted to ascertain the upper limits of measurement accuracy and to guide selection of the pinhole diameter. Investigations of the relative merits of different PS/PDI configurations accompany a general study of the most significant sources of systematic measurement errors. to overcome a variety of experimental difficulties, several new methods in interferogram analysis and phase-retrieval were developed: the Fourier-Transform Method of Phase-Shift Determination, which uses Fourier-domain analysis to improve the accuracy of phase-shifting interferometry; the Fourier-Transform Guided Unwrap Method, which was developed to overcome difficulties associated with a high density of mid-spatial-frequency blemishes and which uses a low-spatial-frequency approximation to the measured wavefront to guide the phase unwrapping in the presence of noise; and, finally, an expedient method of Gram-Schmidt orthogonalization which facilitates polynomial basis transformations in wave- front surface fitting procedures.
NTIS
Extreme Ultraviolet Radiation; Interferometry; Lithography

19990039632 Department of Energy, Assistant Secretary for Environment, Washington, DC USA
Phase retrieval techniques for adaptive optics
Carrano, C., Department of Energy, USA; Mar. 01, 1998; 13p; In English; Astronomical Telescopes and Instrumentation, USA; Sponsored by International Society for Optical Engineering, USA
Report No.(s): DE98-058609; UCRL-JC-130921; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
We have developed and tested a method for minimizing static aberrations in adaptive optics systems. In order to correct the static phase aberrations, we need to measure the aberrations through the entire system. We have employed various phase retrieval algorithms to detect these aberrations. We have performed simulations of our experimental setup demonstrating that phase retrieval can improve the static aberrations to below the 20 nm rms level, with the limiting factor being local turbulence in the A0 system. Experimentally thus far, we have improved the static aberrations down to the 50 nm level, with the limiting factor being the ability to adjust the deformable mirror. This should be improved with better control algorithms now being implemented.
NTIS
Aberration; Adaptive Optics; Algorithms; Deformable Mirrors; Telescopes

19990040226 Department of Energy, Washington, DC USA
Education and training in optics fabrication: establishing unique partnerships to address workforce training needs for optics and other high technology manufacturing
Kiernan, K., Department of Energy, USA; Mar. 11, 1998; 6p; In English; Diffractive Optic and Micro Optics, 1998, USA
Report No.(s): DE98-058729; UCRL-JC-129319; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
Over the past several years much concern has been voiced about the lack of trained technologists to support high-technology industry and manufacturing in the USA. Attracting and training both new members and upgrading and retraining current members of this area of the workforce has many challenges to address before adequate numbers of well trained individuals will be available to fill the growing demand and help secure our nation's economic industrial edge. Among the concerns are the lack of effective training programs, available funding, career image, and vehicles to educate the public on the availability of positions and excellent rate of compensation. These concerns which effect many areas of industrial manufacturing have been highlighted by government organizations, such as the Department of Labor statistics, and professional journals and publications. In the specific area of optical fabrication, journals such as ''Laser Focus: and Photon & Spectra'' have dedicated articles and editorials discussing the lack of optical fabrication training resources in the USA. Examples of other vocational areas lacking skilled workers, such as precision machinists, are reflected in articles in other publications such as ''Manufacturing Engineering''. The rising concern by both industry and educational institutions has given rise to examining new and innovative approaches to cooperatively solving these problems. In 1994, the American Association of Community Colleges in collaboration with the U.S. Department of Labor, published a study on creative partnerships between community colleges, business, industry and governmental organizations. The premise developed by the research editor was that while partnerships between colleges and private and public sectors have been developed with great benefit for many years, the challenges facing all parties concerned with workforce development going into a new century will require a new magnitude of creativity. Discussions among both industrial and educational audiences have highlighted this growing concern in a way that is bringing about new ways of thinking in joint collaborations which can successfully, and cost effectively, solve these shortages. Through unique partnering approaches between educational institutions, industry, and national laboratories, new cost-effective workforce training and retraining programs are being developed to maintain this nation's leadership role in high-technology industrial development. Successful new technician training programs currently being pursued through critical links between Lawrence Livermore National Laboratory (LLNL), community colleges, industry, and high schools

are meeting both employer and trainee needs. Currently, under memorandums of agreement which provide for the sharing of curriculum, technical expertise, equipment, and public awareness, identified needs for enhanced optician, laser electro-optic technologist, machinist, and rapid transit operator technical training are being addressed. This session will describe these industry-driven programs, with particular emphasis on the optician training collaborative developed by LLNL, Monroe Community College, and American Precision Manufacturers Association (APOMA) industrial representatives to support the needs of the nation's optics industry, including the National Ignition Facility (NIF). The $1.2 billion ND? will be the world's largest optical instrument and is currently the U.S.'s largest R&D project. It will require more than 7,000 meter-class precision optics and more than 15, 000 small precision optics. The national capacity for large laser optics fabrication must be increased substantially over its current level, and optics fabrication costs reduced by a factor of two to four times to achieve this goal. It is imperative that an enhanced skilled technical workforce pool be available to enable the U.S. optics industry to successfully meet this challenge. Through collaborative efforts which bring together the strengths of Monroe Community College, LLNL, and APOMA, an enhanced training program focusing on helping meet this demand is successfully moving forward. LLNL and APOMA industries have provided much needed equipment to assist Monroe Community College in enhancing their program with additional hands- on courses which are critical to the rounded education of the students graduating and entering a highly competitive workforce. to date, APOMA has donated equipment valued at over $800,000 and LLNL $500,000. Additionally, through an active industrial advisory board, teamed efforts with the college are helping to develop a responsive, well balanced curriculum which provides students industry identified state-of-the-art skills. The benefit to the students is a more relevant education which, in turn, provides employers well trained entry level employees which means quicker productivity time and lower costs to the employers.
NTIS
Optical Equipment; Education; Manufacturing; Electro-Optics

19990040817 Department of Energy, Office of Energy Research, Washington, DC USA
Low level absorptance measurements and scans of high performance optical coatings for atomic vapor laser isotope separation applications
Chow, R.; Taylor, J. R.; Wu, Z. L.; Krupka, R.; Yang, T.; Jan. 24, 1998; 7p; In English; Optical interference coatings topical
Report No.(s): DE98-058722; UCRL-JC-129622; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
A surface thermal lensing and a radiometric technique was used to characterize the absorptance dependence on time, power, site, and technique of low absorptance optical multilayered coatings.
NTIS
Absorptance; Atoms; Vapors; Laser Applications; Isotope Separation; Optical Scanners

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PLASMA PHYSICS

Includes magnetohydrodynamics and plasma fusion. For ionospheric plasmas see 46 Geophysics. For space plasmas see90 Astrophysics.

19990038352 Rutherford Appleton Lab., Chilton, UK
Optimisation of Narrow Band Extreme UV Conversion Efficiency of Picosecond Laser Plasma Sources: TMR Large-Scale Facilities Access Programme
Bijkerk, F., FOM-Inst. voor Plasmafysica, Netherlands; Stuik, R., FOM-Inst. voor Plasmafysica, Netherlands; Shamaenok, L. A., FOM-Inst. voor Plasmafysica, Netherlands; Sorokin, A. A., Ioffe (A. F.) Physical-Technical Inst., Russia; Turcu, I. C. E., Rutherford Appleton Lab., UK; Shaikh, W., Rutherford Appleton Lab., UK; Spencer, N., Rutherford Appleton Lab., UK; Feb. 26, 1999; ISSN 1358-6254; In English; Sponsored in part from INCO-Copernicus
Contract(s)/Grant(s): ERBFMGECT950053
Report No.(s): RAL-TR-1999-002; Copyright; Avail: Issuing Activity (CLRC, Rutherford Appleton Lab., Chilton, Didcot, Oxfordshire, OX11 0QX, UK), Hardcopy, Microfiche
This report describes the experiment entitled 'Optimization of the Narrow Band Extreme UV Conversion efficiency of Picosecond Laser Plasma Sources'; carried out at the Central Laser Facility (CLF) from the 5th May to the 2nd June 1997. The experiment, funded by the Framework IV Large-Scale Facilities Access Scheme, was proposed by Dr. F Bijkerk, FOM- Institute for Plasma Physics Rijnhuizen, Nieuwegein, The Netherlands, and carried out by visiting researchers from the Institute. They were

supported by researchers from Ioffe Physical Technical Institute, Russia and the Central Laser Facility, Rutherford Appleton Laboratory.
Derived from text
Laser Plasmas; Optimization; Plasma Physics; Narrowband; Laser Outputs

19990038365 Department of Energy, Washington, DC USA
Simulation of plasma based semiconductor processing using block structured locally refined grids
Wake, D. D., Department of Energy, USA; Jan. 01, 1998; 158p; In English
Report No.(s): DE98-054137; UCRL-LR-129296; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

We have described a new numerical method for plasma simulation. Calculations have been presented which show that the method is accurate and suggest the regimes in which the method provides savings in Central Processing Unit (CPU) time and memory requirements. A steady state simulation of a four centimeter domain was modeled with sheath scale (150 microns) resolution using only 40 grid points. Simulations of semiconductor processing equipment have been performed which imply the usefulness of the method for engineering applications. It is the author's opinion that these accomplishments represent a significant contribution to plasma simulation and the efficient numerical solution of certain systems of non-linear partial differential equations. More work needs to be done, however, for the algorithm to be of practical use in an engineering environment. Despite our success at avoiding the dielectric relaxation timestep restrictions the algorithm is still conditionally stable and requires timesteps which are relatively small. This represents a prohibitive runtime for steady state solutions on high resolution grids. Current research suggests that these limitations may be overcome and the use of much larger timesteps will be possible.
NTIS
Plasmas (Physics); Semiconductors (Materials); Computerized Simulation; Computational Grids

19990038369 Department of Energy, Office of Energy Research, Washington, DC USA
Development of impedance matching technologies for ICRF antenna arrays
Pinsker, R. I., Department of Energy, USA; Mar. 31, 1998; 21p; In English
Report No.(s): DE98-004679; GA-A22817; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

All high power Ion Cyclotron Range of Frequencies (ICRF) heating systems include devices for matching the input impedance of the antenna array to the generator output impedance. For most types of antennas used, the input impedance is strongly time-dependent on timescales as rapid as 10-4 s, while the rf generators used are capable of producing full power only into a stationary load impedance. Hence, the dynamic response of the matching method is of great practical importance. In this paper, world-wide developments in this field over the past decade are reviewed. These techniques may be divided into several classes. The edge plasma parameters that determine the antenna array's input impedance may be controlled to maintain a fixed load impedance. The frequency of the rf source can be feedback controlled to compensate for changes in the edge plasma conditions, or fast variable tuning elements in the transmission line between the generator output and the antenna input connections can provide the necessary time-varying impedance transformation. In lossy passive schemes, reflected power due to the time- varying impedance of the antenna array is diverted to a dummy load. Each of these techniques can be applied to a pre-existing antenna system. If a new antenna is to be designed, recent advances allow the antenna array to have the intrinsic property of presenting a constant load to the feeding transmission lines despite the varying load seen by each antenna in the array.
NTIS
Ion Cyclotron Radiation; Antenna Arrays; Antenna Design; Heating; Impedance Matching

19990038379 Department of Energy, Office of Energy Research, Washington, DC USA
Dynamics of seed magnetic island formation due to geometrically coupled perturbations
Hegna, C. C., Department of Energy, USA; Callen, J. D., Department of Energy, USA; LaHaye, R. J., Department of Energy, USA; Jun. 30, 1998; 24p; In English
Report No.(s): DE98-007138; UW-CPTC-98-5; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Seed magnetic island formation due to a dynamically growing external source in toroidal confinement devices is modeled as an initial value forced reconnection problem. For an external source whose amplitude grows on a time scale quickly compared to the Sweet-Parker time of resistive magnetohydrodynamics, the induced reconnection is characterized by a current sheet and a reconnected flux amplitude which lags in time the source amplitude. This suggests that neoclassical tearing modes, whose excitation requires a seed magnetic island, are more difficult to cause in high Lundquist number plasmas.
NTIS
Magnetic Islands; Seeds; Geometry; Perturbation

19990039090 Air Force Inst. of Tech., School of Engineering, Wright-Patterson AFB, OH USA

Double Layer Effects on Shock Wave Propagation

Walker, Shannon L.; Mar. 1999; 102p; In English

Report No.(s): AD-A361428; AFIT/GAP/ENP/99M-15; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

An analysis and assessment of two mechanisms in plasma shock interactions was conducted under conditions typically encountered in a weakly ionized glow discharge. The mechanisms of a spatially-dependent electron temperature and additional electron impact ionization at the shock front were examined for effects on shock structure and propagation. These mechanisms were incorporated into an existing one-dimensional, time-dependent, fluid dynamics code that uses the Riemami problem as a basis and numerically solves the Euler equations for two fluids: the neutral gas and the charged component. The spatial variation in electron temperature was modeled as a shock-centered rise in temperature. Additional ionization was modeled by incorporating a variable electron temperature and a quasi-kinetic collision function, for both unrestricted ionization and ionization mitigated by ion-electron recombination. Introduction of a spatial variation in electron temperature resulted in a broadening and strengthening of the electric field associated with the electronic double layer (EDL) at the shock front. Results of unrestricted ionization were a broadening and strengthening of the electric field associated with the EDL, acceleration of the neutral shock front, and the development of a neutral precursor ahead of the shock. Ion-electron recombination was seen to reduce these effects.

DTIC

Shock Waves; Glow Discharges; Plasma Interactions; Shock Wave Propagation; Neutral Gases; Spatial Distribution

19990039126 Department of Energy, Washington, DC USA

Wire array z-pinch insights for high x-ray power generation

Sanford, T. W. L., Department of Energy, USA; Mock, R. C., Department of Energy, USA; Nash, T. J., Department of Energy, USA; Aug. 31, 1998; 25p; In English; 12th; High Power Particle Beams, USA

Report No.(s): DE98-006187; SAND-97-3168; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The discovery that the use of very large numbers of wires enables high x-ray power to be generated from wire-array z-pinches represents a breakthrough in load design for large pulsed power generators, and has permitted high temperatures to be generated in radiation cavities on Saturn. In this paper, changes in x-ray emission characteristics as a function of wire number, array mass, and load radius, for 20-mm-long aluminum arrays on Saturn that led to these breakthrough hohlraum results, are discussed and compared with a few related emission characteristics of high-wire-number aluminum and tungsten arrays on Z. X=ray measurement comparisons with analytic models and 2-D radiation-magnetohydrodynamic (RMHC) code simulations in the x-y and r-z planes provide confidence in the ability of the models and codes to predict future x-ray performance with very-large-number wire arrays.

NTIS

Zeta Pinch; Magnetohydrodynamics; Wire; Pulse Generators; X Rays; Electric Generators

19990039133 Department of Energy, Office of Energy Research, Washington, DC USA

Generalized reduced MHD equations

Kruger, S. E., Department of Energy, USA; Hegna, C. C., Department of Energy, USA; Callen, J. D., Department of Energy, USA; Jul. 31, 1998; 39p; In English

Report No.(s): DE98-007139; UW-CPTC-98-8; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

A new derivation of reduced magnetohydrodynamic (MHD) equations is presented. A multiple-time-scale expansion is employed. It has the advantage of clearly separating the three time scales of the problem associated with (1) MHD equilibrium, (2) fluctuations whose wave vector is aligned perpendicular to the magnetic field, and (3) those aligned parallel to the magnetic field. The derivation is carried out without relying on a large aspect ratio assumption; therefore this model can be applied to any general toroidal configuration. By accounting for the MHD equilibrium and constraints to eliminate the fast perpendicular waves, equations are derived to evolve scalar potential quantities on a time scale associated with the parallel wave vector (shear-alfven wave time scale), which is the time scale of interest for MHD instability studies. Careful attention is given in the derivation to satisfy energy conservation and to have manifestly divergence-free magnetic fields to all orders in the expansion parameter. Additionally, neoclassical closures and equilibrium shear flow effects are easily accounted for in this model. Equations for the inner resistive layer are derived which reproduce the linear ideal and resistive stability criterion of Glasser, Greene, and Johnson.

NTIS

Magnetohydrodynamics; Plasma Equilibrium; Magnetohydrodynamic Stability; Transport Theory; Magnetohydrodynamic Waves; Shear Flow; Equilibrium Flow

19990039143 Department of Energy, Office of Energy Research, Washington, DC USA

Continued development of modeling tools and theory for RF heating

Dec. 31, 1998; 20p; In English

Report No.(s): DE99-001088; DOE/ER/54129-T1; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Mission Research Corporation (MRC) is pleased to present the Department of Energy (DOE) with its renewal proposal to the Continued Development of Modeling Tools and Theory for RF Heating program. The objective of the program is to continue and extend the earlier work done by the proposed principal investigator in the field of modeling Radio Frequency (RF) heating experiments in the large tokamak fusion experiments, particularly the Tokamak Fusion Test Reactor (TFTR) device located at Princeton Plasma Physics Laboratory (PPPL). An integral part of this work is the investigation and, in some cases, resolution of theoretical issues which pertain to accurate modeling. MRC is nearing the successful completion of the specified tasks of the Continued Development of Modeling Tools and Theory for RF Heating project. The following tasks are either completed or nearing completion. (1) Anisotropic temperature and rotation upgrades; (2) Modeling for relativistic ECRH; (3) Further documentation of SHOOT and SPRUCE. As a result of the progress achieved under this project, MRC has been urged to continue this effort. Specifically, during the performance of this project two topics were identified by PPPL personnel as new applications of the existing RF modeling tools. These two topics concern (a) future fast-wave current drive experiments on the large tokamaks including TFTR and (c) the interpretation of existing and future RF probe data from TFTR. to address each of these topics requires some modification or enhancement of the existing modeling tools, and the first topic requires resolution of certain theoretical issues to produce self-consistent results. This work falls within the scope of the original project and is more suited to the project's renewal than to the initiation of a new project.

NTIS

Radio Frequency Heating; Plasma Physics

19990039201 Department of Energy, Assistant Secretary for Fossil Energy, Washington, DC USA

Assessment of effects of neutrals on the power threshold for L to H transitions in D3-D

Owen, L. W., Department of Energy, USA; Carreras, B. A., Department of Energy, USA; Maingi, R., Department of Energy, USA; Mioduszewski, P. K., Department of Energy, USA; Carlstrom, T. N., Department of Energy, USA; Sep. 30, 1997; 8p; In English; US/Japan H-mode Physics, USA, USA

Report No.(s): DE98-000334; ORNL/CP-94439; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

To assess the effect of edge neutrals on the low to high confinement transition threshold, a broad range of plasma discharges has been analyzed. From this analysis, the transition power divided by the density, at constant magnetic field, appears to be a function of a single parameter measuring the neutrals' effect, This parameter cannot be uniquely identified. For instance, it may be the radial decay length of the neutral profile or the charge exchange damping rate at about r/a approx. 0.95. This results suggest that there is a missing parameter linked to the neutrals in the power threshold scaling laws.

NTIS

Neutral Particles; Plasma Jets; Plasma Control; Threshold Gates

19990039202 Department of Energy, Office of Energy Research, Washington, DC USA

Challenges for the ITER ion cyclotron system

Swain, D. W., Department of Energy, USA; Ryan, P. M., Department of Energy, USA; Taylor, D. J., Department of Energy, USA; Bosia, G., Department of Energy, USA; Sep. 30, 1997; 10p; In English; 12th; Radio Frequency Power in Plasmas, USA

Report No.(s): DE98-000335; ORNL/CP-94436; CONF-9704102; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Ion cyclotron heating is one of the methods proposed for heating and for driving current in the ITER plasma. The ITER environment is significantly different from that of present day tokamak because of heating from neutrons and from the high radiated heat flux. In addition, the proposed 15 cm gap between the plasma separatrix and the outer wall (where the ion cyclotron antennas are located) necessitates running the antennas at relatively high values of voltage in order to couple the required power to the plasma. There are two main questions: (1) Can the ion cyclotron antennas deliver the required power to the plasma. (2) Can they survive in the ITER environment. Results presented in this paper indicate that the antennas can survive both normal operation and disruptions in ITER, and can deliver the power to the plasma.

NTIS

Stress Analysis; Thermal Analysis; Procedures; Technology Assessment; Heating; Tokamak Devices; Thermonuclear Reactions

19990039213 Department of Energy, Office of Energy Research, Washington, DC USA

In-vessel tritium retention and removal in ITER

Federici, G., Department of Energy, USA; Anderl, R. A., Department of Energy, USA; Andrew, P., Department of Energy, USA; Dec. 31, 1998; 75p; In English; 13th; Plasma Surface Interactions, USA

Report No.(s): DE98-005903; SAND-98-1340C; CONF-980560; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The International Thermonuclear Experimental Reactor (ITER) is envisioned to be the next major step in the world's fusion program from the present generation of tokamaks and is designed to study fusion plasmas with a reactor relevant range of plasma parameters. During normal operation, it is expected that a fraction of the unburned tritium, that is used to routinely fuel the discharge, will be retained together with deuterium on the surfaces and in the bulk of the plasma facing materials (PFMs) surrounding the core and divertor plasma. The understanding of he basic retention mechanisms (physical and chemical) involved and their dependence upon plasma parameters and other relevant operation conditions is necessary for the accurate prediction of the amount of tritium retained at any given time in the ITER torus. Accurate estimates are essential to assess the radiological hazards associated with routine operation and with potential accident scenarios which may lead to mobilization of tritium that is not tenaciously held. Estimates are needed to establish the detrition requirements for coolant water, to determine the plasma fueling and tritium supply requirements, and to establish the needed frequency and the procedures for tritium recovery and clean-up. The organization of this paper is as follows. Section 2 provides an overview of the design and operating conditions of the main components which define the plasma boundary of ITER. Section 3 reviews the erosion database and the results of recent relevant experiments conducted both in laboratory facilities and in tokamaks. These data provide the experimental basis and serve as an important benchmark for both model development (discussed in Section 4) and calculations (discussed in Section 5) that are required to predict tritium inventory build- up in ITER. Section 6 emphasizes the need to develop and test methods to remove the tritium from the codeposited C-based films and reviews the status and the prospects of the most attractive techniques. Section 7 identifies the unresolved issues and provides some recommendations on potential R and D avenues for their resolution. Finally, a summary is provided in Section 8.

NTIS

Tritium; Tokamak Devices; Retaining; Cleaning; Refueling; Thermonuclear Reactions

19990039574 Department of Energy, Washington, DC USA

Energetic alpha particle transport method EATM

Kirkpatrick, R. C., Department of Energy, USA; Feb. 28, 1998; 12p; In English; 5th; Computational Math, USA

Report No.(s): DE98-002930; LA-UR-97-4790; CONF-9709141; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The EATM method is an evolving attempt to find an efficient method of treating the transport of energetic charged particles in a dynamic magnetized (MHD) plasma for which the mean free path of the particles and the Larmor radius may be long compared to the gradient lengths in the plasma. The intent is to span the range of parameter space with the efficiency and accuracy thought necessary for experimental analysis and design of magnetized fusion targets.

NTIS

Alpha Particles; Transport Properties; Particle Motion; Procedures; Experiment Design; Energetic Particles

19990039575 Department of Energy, Washington, DC USA

Time dependent view factor methods

Kirkpatrick, R. C., Department of Energy, USA; Mar. 31, 1998; 12p; In English; 5th; Computational Math, USA

Report No.(s): DE98-002931; LA-UR-97-4636; CONF-9709141; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

View factors have been used for treating radiation transport between opaque surfaces bounding a transparent medium for several decades. However, in recent years they have been applied to problems involving intense bursts of radiation in enclosed volumes such as in the laser fusion hohlraums. In these problems, several aspects require treatment of time dependence.

NTIS

Time Dependence; Procedures; Radiation Transport; Laser Plasmas

19990039596 Department of Energy, Office of Energy Research, Washington, DC USA

Disruption Studies in DIII-D

Kellman, A. G., Department of Energy, USA; Cuthbertson, J. W., Department of Energy, USA; Luckhardt, S., Department of Energy, USA; Zhang, J., Department of Energy, USA; Lee, R. L., Department of Energy, USA; Dec. 31, 1997; 10p; In English;

16th; Fusion Energy, USA; Sponsored by International Atomic Energy Agency, Austria
Report No.(s): DE98-000586; ORNL/CP-94771; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Characteristics of disruptions in the DIII-D tokamak including the current decay rate, halo current magnitude and toroidal asymmetry. and heat pulse to the divertor are described. Neon and argon pellet injection is shown to be an effective method of mitigating the halo currents and the heat pulse with a 50% reduction in both quantities achieved. The injection of these impurity pellets frequently gives rise to runaway electrons.

NTIS

Tokamak Devices; Disrupting

19990039622 Department of Energy, Washington, DC USA

Status of experiments leading to a small recirculator

Sangster, C. T., Department of Energy, USA; Barnard, J. J., Department of Energy, USA; Cianciolo, T. V., Department of Energy, USA; Jan. 16, 1998; 15p; In English; 8th; 12th; Heavy-ion Inertial Fusion, USA, USA
Report No.(s): DE98-057752; UCRL-JC-129503; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

A heavy ion linear induction accelerator is considered to be the leading driver candidate for an Inertial Fusion Energy reactor. to deliver a space-charge-dominated beam at the appropriate energy (several GeV), such an accelerator would be several kilometers in length. Since total length has a strong influence on accelerator cost, we are considering the potential advantages and practical implementation of a recirculating induction accelerator. to address the critical scientific and technical challenges of a recirculating space-charge-dominated heavy ion beam, we have begun to develop the elements of a scaled 'small recirculator'. An operating recirculator must demonstrate full beam control including multi-lap operation, beam insertion/extraction, acceleration and pulse compression. At present, experiments have been conducted using a 2mA, 80keV K(+) beam transported through a 45 deg bend; experiments on a 90 deg bend with five induction modulators will begin soon. This paper briefly summarizes the recirculator specifications and operational features and reports the latest experimental data as well as the developmental status of beam diagnostics.

NTIS

Ion Accelerators; Inertial Fusion (Reactor); Ion Beams; Linear Accelerators

19990039624 Department of Energy, Washington, DC USA

Design for environment for the National Ignition Facility

Cantwell, E., Department of Energy, USA; Gobor, K., Department of Energy, USA; Celeste, J., Department of Energy, USA; Cerruti, S., Department of Energy, USA; May 01, 1998; 25p; In English; 14th; Pollution Prevention, USA
Report No.(s): DE98-057773; UCRL-JC-129940; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The National Ignition Facility (NIF) will be a U.S. Department of Energy (DOE) national center for inertial confinement fusion (ICF) and other research into the physics of high temperatures and high densities, and a vital element of the DOE's nuclear weapons Stockpile Stewardship and Management Program. This paper discusses the Design for Environment process for NIF, some of the subsequent activities resulting from the initial study, and a few of the lessons learned from this process. Subsequent activities include the development of a Pollution Prevention and Waste Minimization Plan (P2/WMin) for the facility, which includes Pollution Prevention Opportunity Assessments (PPOAS) on predicted waste streams from NIF, development of construction phase recycling plans, analysis of some of the specialized materials of construction to minimize future demolition and decommissioning (D and D) costs and development of cost assessments for more benign cleaning procedures that meet the stringent cleaning specifications for this facility.

NTIS

Inertial Confinement Fusion; Nuclear Weapons; Construction; Environment Effects

19990039625 Department of Energy, Office of Energy Research, Washington, DC USA

Turbulences in boundary plasmas

Xu, X., Department of Energy, USA; May 15, 1998; 11p; In English; 13th; Plasma Surface Interactions, USA
Report No.(s): DE98-057938; UCRL-JC-129481; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

We simulate boundary plasma turbulence using a 3D turbulence code BOUT and a linearized electromagnetic instability shooting code BAL. The code BOUT solves fluid equations for plasma vorticity, density, ion temperature, and parallel momentum (along the magnetic field), electron temperature, and parallel momentum. A realistic DIII-D X point magnetic geometry is used. The focus is on the possible local linear instability drivers and turbulence suppression mechanisms from L to H mode. Comparison

is made with data from the DIII-D tokamak where probe measurements provide turbulence statistics in the boundary plasma and transport modeling.
NTIS
Plasma Turbulence; Magnetohydrodynamic Stability; Boundary Layers; Computer Programs

19990039627 Department of Energy, Office of Energy Research, Washington, DC USA
Overview of the WARP code and studies of transverse resonance effects
Friedman, A., Department of Energy, USA; May 31, 1998; 6p; In English; Space Charge Physics in High Intensity Hadron Rings, USA
Report No.(s): DE98-058590; UCRL-JC-130865; No Copyright; Avail: Issuing Activity, Microfiche
Two papers presented at the Shelter Island workshop are very briefly summarized here, in view of recent publications elsewhere. The WARP code, developed for Heavy-Ion beam-driven inertial confinement Fusion (HIF) accelerator studies, combines features of a particle-in-cell plasma simulation and an accelerator tracking program. Its methods and architecture have been developed for efficiency both in detailed simulation of individual machine sections and in long-time beam tracking. The transverse 'slice' model in the code has been applied to the study of transverse resonance effects associated with quadrupole strength errors. These simulations confirm that rapid passage through a resonance can reduce the associated mismatch and emittance growth References to published details and to other sources of information are supplied.
NTIS
Computer Programs; Inertial Confinement Fusion; Ion Beams; Plasmas (Physics)

19990039630 Department of Energy, Office of Energy Research, Washington, DC USA
Edge plasma modeling of limiter surfaces in a Tokamak divertor configuration
Rensink, M., Department of Energy, USA; May 11, 1998; 12p; In English; 13th; Plasma Surface Interactions, USA
Report No.(s): DE98-058606; UCRL-JC-130763; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
During the startup phase of a tokamak the plasma configuration may evolve from a limiter to a divertor configuration. Some of the particle and heat flux from the core will be deposited on material surfaces near the separatrix instead of the divertor plates. Examples of such surfaces include the center-post in most tokamaks, baffles near the x-point that create closed divertors, and outboard limiter surfaces. Two-dimensional edge plasma models for tokamak divertor configurations typically give detailed information about the particle and heat fluxes on the divertor plates, but yield little or no information about fluxes on these other localized surfaces near the core plasma. to realistically model the startup phase of a tokamak it is necessary to compute the plasma interaction with both limiter and divertor surfaces. The UEDGE code (l) has been modified to include these limiter surfaces. In this report we present simulation results for an idealized ITER (2) startup configuration with variations in the limiter penetration depth and surface shape.
NTIS
Thermonuclear Reactions; Tokamak Devices; Computerized Simulation; Two Dimensional Models; Computer Programs; Fusion Reactors

19990039631 Department of Energy, Office of Energy Research, Washington, DC USA
Effect of divertor geometry on plasma detachment in DIII-D
Wolf, N., Department of Energy, USA; May 19, 1998; 9p; In English; 13th; Plasma Surface Interactions, USA
Report No.(s): DE98-058607; UCRL-JC-130753; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
This paper explores the physics of the recently installed Radiative Divertor Plasma divertor (RDP) in DIII-D through the use of UEDGE simulation with experimentally derived plasma parameters. The RDP is a nearly closed baffle and cryopumping system in the upper divertor of DIII-D. One measure of the effectiveness of the RDP is the achievement of a detached plasma with a lower core density than in the open divertor (present in the lower divertor in DIII-D). Plasma detachment, observed on all diverted tokamaks, is a change in the plasma state which results in a decrease in both the ion current and heat load on the divertor plate. These reductions together with the related drop in electron temperature are important for divertor design in high power devices such as ITER, in which detached operation is assumed. Both UEDGE modeling and DIII-D experiments show a reduction of 25% to 50% in the core density necessary for plasma detachment in the RDP compared to the open divertor.
NTIS
Fusion Reactors; Computerized Simulation; Divertors (Fusion Reactors); Plasmas (Physics); Tokamak Devices; Thermonuclear Reactions

19990039634 Department of Energy, Washington, DC USA

Impact of detailed radiation transport on volume recombination

Scott, H., Department of Energy, USA; May 19, 1998; 20p; In English; 13th; Plasma Surface Interactions, USA

Report No.(s): DE98-058713; UCRL-JC-130835; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Recently both the Alcator C-Mod and DIII-D tokamaks observed significant recombination of major ion species in the divertor region during detachment. For sufficiently low temperatures the mixture of neutral atoms and ions can be optically thick to line radiation. The optical depth of the recombined region to Ly(alpha) radiation can be very large and opacity effects and radiation trapping can dramatically change the heat flux to the divertor walls. This paper presents an analysis of the effect of line radiation on volume recombination using CRETIN, a multi-dimensional, non-local thermodynamic equilibrium simulation code that includes the atomic kinetics and radiative transport processes necessary to model this complex environment.

NTIS

Radiation Transport; Tokamak Devices; Divertors (Fusion Reactors); Radiation Effects; Computerized Simulation; Ions; Radiation Trapping

19990040228 Department of Energy, Washington, DC USA

Theory of edge plasma in a spheromak

Hooper, E. B., Department of Energy, USA; May 01, 1998; 17p; In English; 13th; Plasma Surface Interactions, USA

Report No.(s): DE98-058849; UCRL-JC-130767; No Copyright; Avail: Issuing Activity, Microfiche

Properties of the edge plasma in the SSPX spheromak during the plasma formation and sustainment phases are discussed. For the breakdown and formation phase, the main emphasis is on the analysis of possible plasma contamination by impurities from the electrodes of the plasma gun (helicity injector). The issue of an azimuthally uniform breakdown initiation is also discussed. After the plasma settles down in the main vacuum chamber, one has to sustain the current between the electrodes, in order to continuously inject helicity. We discuss properties of the plasma on the field lines intersecting the electrodes. We conclude that the thermal balance of this plasma is maintained by Joule heating competing with parallel heat losses to the electrodes. The resulting plasma temperature is in the range of 15 - 30 eV. Under the expected operational conditions, the ''current'' velocity of the electrons is only slightly below their thermal velocity. Implications of this observation are briefly discussed.

NTIS

Spheromaks; Plasma Composition; Ohmic Dissipation; Plasma Guns; Impurities; Plasma Temperature

19990040229 Department of Energy, Office of Energy Research, Washington, DC USA

Influence of ExB and nabla(B) deift terms in 2-D edge/SOL transport simulations

Rognlien, T., Department of Energy, USA; May 15, 1998; 15p; In English; 13th; Plasma Surface Interactions, USA

Report No.(s): DE98-058885; UCRL-JC-130761; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Classical particle drifts across the magnetic field can play an important role in tokamak edge-plasma transport. The relative influence of these terms is studied for self-consistent simulations by including them, together with anomalous diffusion transport, in a 2-D fluid model of edge-plasma transport for the DIII-D tokamak geometry. The drifts cause asymmetries in the plasma equilibrium which depend on the direction of the magnetic field, B. The basic results can be understood by dividing the drifts into three categories: diamagnetic, ExB, and nabla(B). The dominant effect near the divertor plates is from the ExB drifts, while the weaker nabla(B) drifts cause an increase in the magnitude of the radial electric field inside the magnetic separatrix. The diamagnetic terms, defined as divergence free, do not contribute to transport.

NTIS

Transport Theory; Magnetic Fields; Charged Particles; Tokamak Devices; Plasma Equilibrium; Electric Fields

19990040230 Department of Energy, Office of Energy Research, Washington, DC USA

Collaboratory for support of scientific research

Casper, T. A., Department of Energy, USA; Meyer, W. H., Department of Energy, USA; Moller, J. M., Department of Energy, USA; Jun. 25, 1998; 14p; In English; 25th; Controlled Fusion and Plasma Physics, USA

Report No.(s): DE98-058890; UCRL-JC-131094; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Collaboration is an increasingly important aspect of magnetic fusion energy research. With the increased size and cost of experiments needed to approach reactor conditions, the numbers being constructed has become limited. In order to satisfy the desire for many groups to conduct research on these facilities, we have come to rely more heavily on collaborations. Fortunately, at the same time, development of high performance computers and fast and reliable wide area networks has provided technological solutions necessary to support the increasingly distributed work force without the need for relocation of entire research staffs. Development of collaboratories, collaborative or virtual laboratories, is intended to provide the capability needed to interact from

afar with colleagues at multiple sites. These technologies are useful to groups interacting remotely during experimental operations as well as to those involved in the development of analysis codes and large scale simulations The term ''collaboratory'' refers to a center without walls in which researchers can perform their studies without regard to geographical location - interacting with colleagues, accessing instrumentation, sharing data and computational resources, and accessing information from digital libraries. While it is widely recognized that remote collaboration is not a universal replacement for personal contact, it does afford a means for extending that contact in a manner that minimizes the need for relocation and for travel while more efficiently utilizmg resources and staff that are geographically distant from the central facility location, be it an experiment or design center While the idea of providing a remote environment that is ''as good as being there'' is admirable, it is also important to recognize and capitalize on any differences unique to being remote (3) Magnetic fusion energy research is not unique in its increased dependence on and need to improve methods for collaborative research Many research disciplines find themselves in a similar position, trying to better utilize facilities and increase productivity for both local and remote researchers A recently published issue of Interactions (4) includes a special section dedicated to collaboratories A description of collaborative observations at the Keck Observatory (2) indicates distinct and real advantages gamed by astronomers who can now remotely access this facility, even as the collaboratory is developing. Advantages range from simply making the facility available to more researchers without the cost of travel to the physiological advantage of not experiencing oxygen deprivation sickness due to high altitude observing The Upper Atmospheric Research Collaboratory (2) which focuses on studies of the earth's ionosphere and interactions with the solar wind now combines information from several observing sites, many in difficult to reach high latitude locations above the arctic circle Travel to these remote locations, fomrerly provided by military flights which are no longer needed, is now more expensive for researchers With a now obvious need for remote sensing and collaborations, the UARC has combined access to these experimental facilities and joined in global modeling efforts to better use the capabilities of researchers on an international scale. The final collaboratory featured (2) is that of our testbed development for the DIII-D tokamak experiment 141 to make it even more accessible in its role as a US national facility.

NTIS

Nuclear Fusion; Energy Technology; Remote Control; Tokamak Devices; Wide Area Networks; Distributed Processing

19990040588 Department of Energy, Office of Energy Research, Washington, DC USA

Tritium concentration measurements in the JET divertor by optical spectroscopy of a Penning discharge

Hillis, D. L., Department of Energy, USA; Morgan, P. D., Department of Energy, USA; Ehrenberg, J. K., Department of Energy, USA; Groth, M., Department of Energy, USA; Stamp, M. F., Department of Energy, USA; Jun. 30, 1998; 17p; In English; 12th; High Temperature Plasma Diagnostics, USA

Report No.(s): DE98-003585; ORNL/CP-98498; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Obtaining precision measurements of the relative concentrations of hydrogen, deuterium, tritium, and helium in the divertor of a tokamak are an important task for nuclear fusion research. Control of the deuterium-tritium isotopic ratio while limiting the helium ash content in a fusion plasma are key factors for optimizing the fuel burn in a fusion reactor, like the International Tokamak Experimental Reactor (ITER). A diagnostic technique has been developed to measure the deuterium-tritium isotopic ratio in the divertor of the Joint European Torus (JET) with a species-selective Penning vacuum gauge. The Penning discharge provides a source of electrons to excite the neutral hydrogen isotopes in the pumping duct. Subsequently, the visible light from the hydrogen isotopes is collected in an optical fiber bundle, transferred away from the tokamak into a low radiation background area, and analyzed in a high resolution Czerny-Turner spectrometer, which is equipped with a fast charge coupled device (CCD) camera for optical detection. The intensity of the observed line emission (D(sub (alpha)) -- 6561.03 (angstrom); and T(sub (alpha)) -- 6560.44 (angstrom)) is directly proportional to the partial pressure of each gas found in the divertor. The line intensity of each isotope is calibrated as a function of pressure. The ratio of the line intensities thus provides a direct measurement of the deuterium-tritium isotopic ratio. The lower limit for the determination of the deuterium-tritium isotopic ratio is about 0.5%. The applicable pressure range for this system is from 10(sup -5) mbar to a few times 10(exp -3) mbar.

NTIS

Tritium; Spectroscopy; Penning Discharge; Optical Measurement; Joint European Torus; Divertors (Fusion Reactors)

19990040695 Los Alamos National Lab., NM USA

Substorm effects in MHD and test particle simulations of magnetotail dynamics

Birn, J.; Hesse, M.; Dec. 31, 1998; 15p; In English; ICS-4: substorms

Report No.(s): DE99-000754; LA-UR-98-2126; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Recent magnetohydrodynamic simulations demonstrate that a global tail instability, initiated by localized breakdown of MHD, can cause plasmoid formation and ejection as well as dipolarization and the current diversion of the substorm current wedge. The connection between the reconnection process and the current wedge signatures is provided by earthward flow from

the reconnection site. Its braking and diversion in the inner magnetosphere causes dipolarization and the magnetic field distortions of the current wedge. The authors demonstrate the characteristic properties of this process and the current systems involved. The strong localized electric field associated with the flow burst and the dipolarization is also the cause of particle acceleration and energetic particle injections. Test particle simulations of injection signatures.
NTIS
Magnetohydrodynamics; Magnetic Fields; Energetic Particles; Simulation

19990040698 Los Alamos National Lab., NM USA
Stability time of a DT-filled cryogenic ICF target in a high vacuum environment
Ebey, P. S.; Hoffer, J. K.; Dec. 31, 1998; 12p; In English; 12th; Target fabrication
Report No.(s): DE99-000739; LA-UR-98-2052; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Following the successful pressure loading with DT of a thin-walled plastic inertial fusion target shell (such as those designed for use at the OMEGA facility at the University of Rochester's Laboratory for Laser Energetics (UR/LLE)), continual care must be taken to safeguard the shell from being exposed to unacceptable pressure differentials across its wall. In particular, once the DT has been condensed into a liquid or solid phase and the outside pressure has been reduced, the target must be maintained below some upper cutoff temperature such that the vapor pressure of the DT is below the bursting pressure for the shell. Through the process of (beta)-decay the DT self-heats, but while the shell is in a high vacuum environment (P (much-lt) 0.8 Pa (6 mtorr) for the OMEGA layering sphere) there is only a negligible heat loss mechanism. This will cause the temperature to increase. A calculation has been done to estimate the rate of temperature increase of the loaded target under high vacuum conditions. A functional form for calculating the target's temperature increase given its starting temperature is presented. An overall result is that under high vacuum conditions the DT changes from a solid at 10 K to a liquid at 37 K (T(sub c) = 39.4 K) in about 19 minutes. This holding time is significantly less if the initial temperature is higher, the initial state is liquid, or the upper allowed temperature is lower. Simplifying assumptions which were made and their impact on interpreting the results of this calculation are discussed.
NTIS
Stability; Cryogenics; High Vacuum; Laser Targets

19990040778 Wisconsin Univ., Madison, WI USA
Spectroscopic measurement of the MHD dynamo in the MST reversed field pinch
Chapman, J. T.; Sep. 30, 1998; 295p; In English
Report No.(s): DE99-001041; DOE/ER/54345-307; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The author has directly observed the coupling of ion velocity fluctuations and magnetic field fluctuations to produce an Magnetohydrodynamics (MHD) dynamo electric field in the interior of the MST reversed field pinch. Chord averaged ion velocity fluctuations were measured with a fast spectroscopic diagnostic which collects line radiation from intrinsic carbon impurities simultaneously along two lines of sight. The chords employed for the measurements resolved long wavelength velocity fluctuations of several km/s at 8--20 kHz as tiny, fast Doppler shifts in the emitted line profile. During discrete dynamo events the velocity fluctuations, like the magnetic fluctuations, increase dramatically. The toroidal and poloidal chords with impact parameters of 0.3 a and 0.6 a respectively, resolved fluctuation wavenumbers with resonance surfaces near or along the lines of sight indicating a radial velocity fluctuation width for each mode which spans only a fraction of the plasma radius. The phase between the measured toroidal velocity fluctuations and the magnetic fluctuations matches the predictions of resistive MHD while the poloidal velocity fluctuations exhibit a phase consistent with the superposition of MHD effects and the advection of a mean flow gradient past the poloidal line of sight. Radial velocity fluctuations resolved by a chord through the center of the plasma were small compared to the poloidal and toroidal fluctuations and exhibited low coherence with the magnetic fluctuations. The ensembled nonlinear product of the ion velocity fluctuations and fluctuations in the magnetic field indicates a substantial dynamo electric field which peaks during the periods of spontaneous flux generation.
NTIS
Spectroscopy; Magnetohydrodynamics

19990040826 Lawrence Livermore National Lab., Livermore, CA USA
Plans for National Ignition Facility operations training and operations procedures
Mantrom, D. D.; Jun. 01, 1998; 7p; In English; Accelerator operations, 1998
Report No.(s): DE98-058844; UCRL-JC-130993; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

A preliminary plan for National Ignition Facility (NIF) Operations training developed for the 200+ staff anticipated to operate the NIF facility is discussed. We also address the development and implementation of NIF Operations procedures. These procedures serve as an essential part of the staff training program. A special aspect of NIF Operations procedures is that they will be

on-line with electronic links to design, operations, and test databases, and will likely incorporate electronic checklists and archiving capabilities.
NTIS
Education; Data Bases

19990040831 Lawrence Livermore National Lab., Livermore, CA USA
Design of precision mounts for optimizing the conversion efficiency of KDP crystals for the National Ignition Facility
Hibbard, R. L.; Mar. 30, 1998; 7p; In English; Diffractive optic and micro optics, 1998
Report No.(s): DE98-058745; UCRL-JC-130317; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

A key design challenge for the National Ignition Facility (NIF), being constructed at Lawrence Livermore National Laboratory (LLNL), (Hibbard, RL, 1998), is the frequency converter consisting of two KDP crystals and a focusing lens Frequency conversion is a critical performance factor for NIF and the optical mount design for this plays a key role in meeting design specifications The frequency converter is a monolithic cell that mounts the optics and is the point on the beamline where the frequency conversion crystals are optimally aligned and the cell is focused on target The lasing medium is neodymium in phosphate glass with a fundamental frequency (1(omega)) of 1053 (micro)m Sum frequency generation in a pair of conversion crystals (KDP/KD*P) produces 18 MJ of the third harmonic light (3(omega) or (lambda)=O 35 pm). The phase-matching scheme on NIF is type I second harmonic generation followed by type II sum-frequency-mixing of the residual fundamental and the second harmonic light This laser unlike previous laser system designs, must achieve high conversion efficiency, 85%, which is close to the 90 8% theoretical maximum As a result, this design is very sensitive to angular variations in beam propagation and in the crystal axes orientation. Factors that influence the phase matching angle include crystal inhomogeneity, residual and induced stress in the crystals, the crystals' natural and mounted surface figure, mounting imperfections and gravity sag These angular variations need to be controlled within a 40 (micro) rad error budget. The optical mount contributions to the angular error budget are 20 (micro)rad and are what make the frequency converter in the Final Optics Cell (FOC) such a challenging precision design. The premise of using full edge support in the FOC design is primarily driven by the spherical target chamber design that has optics mounted at multiple longitudinal angles and thus gravity sag in the crystals that needs to be minimized to meet the angular performance requirements, a precision monolithic cell with full edge support for mounting the optics to 10 (micro)rad angular and 1-5 (micro)m flatness tolerances is required The NIF frequency converter design is a major step in improving both conversion efficiency and precision of the mount design Another major consideration in the FOC design is the trade-off between cost of manufacturing the cell and the performance of the mount An interesting balance of what can be accomplished with a conventional machine tool in a commercial shop to produce prototype FOC' s will be discussed Metrology issues involved in qualifying the FOC are also discussed.
NTIS
Precision; Mounting; Crystals; Design Analysis; Potassium Phosphates

19990040869 Department of Energy, Washington, DC USA
Mirror-based fusion: some possible new directions
Post,; Jul. 16, 1998; 16p; In English; Open magnetic systems for plasma confinement
Report No.(s): DE98-058779; UCRL-JC-130404; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

This paper examines some possible areas for the study of new approaches to fusion research, ones that employ magnetic confinement systems based on open-ended field topology and employing the magnetic mirror principle. In the spirit of encouraging a wider look at possibilities, some unconventional approaches are suggested. These approaches, involving long linear systems having ion injectors and direct converters at their ends, attempt to exploit some inherent advantages of open-ended systems for fusion. The results of analysis, calculations and preliminary cost estimates for long linear systems of this type that utilize the magnetic mirror effect to achieve their operating regimes will be presented. The approaches suggested, when examined in greater depth, may not stand the test of time, but they might encourage thinking in new areas.
NTIS
Mirror Fusion; Magnetic Mirrors

19990040880 Department of Energy, Office of Energy Research, Washington, DC USA
Steam chemical reactivity of plasma-sprayed beryllium
Anderl, R. A., Department of Energy, USA; Pawelko, R. J., Department of Energy, USA; Smolik, G. R., Department of Energy, USA; Castro, R. G., Department of Energy, USA; Dec. 31, 1998; 7p; In English; Sponsored by American Nuclear Society, USA
Report No.(s): DE98-057481; INEEL/CON-98-00019; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Plasma-spraying with the potential for in-situ repair makes beryllium a primary candidate for plasma facing and structural components in experimental magnetic fusion machines. Deposits with good thermal conductivity and resistance to thermal cycling have been produced with low pressure plasma- spraying (LPPS). A concern during a potential accident with steam ingress is the amount of hydrogen produced by the reactions of steam with hot components. In this study, the authors measure the reaction rates of various deposits produced by LPPS with steam from 350 C to above 1,000 C. They correlate these reaction rates with measurements of density, open porosity and BET surface areas. They find the reactivity to be largely dependent upon effective surface area. Promising results were obtained below 600 C from a 94% theoretical dense (TD) deposit with a BET specific surface area of 0.085 sq m/g. Although reaction rates were higher than those for dense consolidated beryllium they were substantially lower, i.e., about two orders of magnitude, than those obtained from previously tested lower density plasma-sprayed deposits.
NTIS
Beryllium; Steam; Chemical Reactions; Plasmas (Physics); Spraying; Arc Spraying

19990040922 Instituto Nacional de Pesquisas Espacias, Inst. Tecnologico de Aeronautica, Sao Jose dos Campos, Brazil
Design of a Low Power Plasma Torch for Production of Diamond Films ***Desenvolvimento de uma Tocha de Plasma de Baixa Potencia para Sintetizcao de Filmes de Diamante***
Barreto, Patricia Regina Pereira, Instituto Nacional de Pesquisas Espacias, Brazil; 1999; 274p; In Portuguese
Report No.(s): INPE-6836-TAE/37; No Copyright; Avail: CASI; A12, Hardcopy; A03, Microfiche

In this thesis, the design and construction details of a low power plasma torch (300 - 2000 W) produced by an arc discharge as well as the characterization results of the arc, of the plasma jet and of the synthesized films are presented. The apparatus was designed according to the unidimensional gas dynamic model and its construction was based on components and equipments already available at the Laboratorio Associado de Plasma of INPE. The discharge was characterized measuring the characteristic curves (voltage x current) for several initial operation conditions. These experimental curves were compared with the theoretical predictions. For a limited range of current two discharge operation modes was observed: glow and arc modes. In the glow mode, the plasma density and temperature were determined using a double electrostatic probe. In the arc mode, the angular frequency of the arc rotation was measured using a specially designed four section anode geometry. Comments about the surface degradation of the electrodes are also presented. In both modes of operation the plasma torch was formed and diamond films were produced and characterized by different techniques as SEM, EDX, x-ray diffraction and Raman spectroscopy. The films produced in the glow mode presented a crystalline phase mixed with an amorphous one and poor uniformity. On the other hand, in the arc mode the films presented only the amorphous phase but good uniformity.
Author
Plasma Torches; Design Analysis; Construction; Theses; Arc Discharges; Diamond Films

19990040925 Los Alamos National Lab., NM USA
Use of intense ion beams for generating magnetized target fusion plasma
Faehl, R. J.; Wood, B. P.; Lindemuth, I. R.; Sheehey, P.; Dec. 31, 1998; 5p; In English; 12th; High Power Particle Beams
Report No.(s): DE99-001133; LA-UR-98-2359; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Magnetized Target Fusion (MTF) is a concept for creating a burning D-T plasma in a potentially inexpensive system. In essence, the concept involves ion heating on time scales short compared to ion transport times plus strong inhibition of thermal electron transport with a transverse magnetic field. The magnetic field is not intended to confine the ionic component. MTF is an intrinsically pulsed concept. A straightforward analysis of MTF indicates that D-T burning conditions can be achieved in compact plasma volumes with modest initial temperatures, through the use of pulsed power technology. In terms of size, density, temperature, and time scales, MTF occupies a position in phase space that is intermediate between steady MFE schemes and ICF. In terms of cost, it is one to two orders of magnitude less expensive than these. In this paper, the authors consider a possible method for creating the initial conditions adequate for the MTF concept through the use intense ion beam injection.
NTIS
Ion Beams; Plasmas (Physics); Fusion (Melting); Beam Injection; Nuclear Propulsion

19990040950 Lawrence Livermore National Lab., Livermore, CA USA
Current profile modeling to extend the duration of high performance advanced Tokamak modes in DIII-D
Casper, T.; Jun. 25, 1998; 7p; In English; 25th; Controlled fusion and plasma physics; Sponsored by European Physical Society, Switzerland
Report No.(s): DE98-058892; UCRL-JC-131088; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

We use a model for negative central shear (NCS) heat transport which has a parametric dependence on the plasma conditions with a transport barrier dependence on the minimum of the safety factor profile, 4, qualitatively consistant with experimental

observations. Our intention is to provide a reasonable model of heat conductivity to be able to simulate effects of electron cyclotron heating (ECH) and current drive (ECCD) on confinement in NCS configurations. We adjust free parameters (c, c1, and c2) in the model to obtain a reasonable representation of the temporal evolution of electron and ion temperature profiles consistent with those measured in selected DIII-D shots. In all cases, we use the measured density profiles rather than self- consistently solve for particle sources and particle transport at this time. In these results, we employ a simple model for the ECH power deposition by providing an externally supplied heat source for the electrons. The heating deposition location and profile are specified as a function of the toroidal flux coordinate to allow us to independently vary the heating dynamics For the results shown here, we assume a Gaussian profile, typically using a width of delta rho=0.05 (delta r-3 cm in minor radius), with rho defined as the square root of toroidal flux All powers are interpreted as that absorbed by the plasma. Similarly, the current drive location and profile are specified with the total current (integrated over the assumed profile) modeled as I(sub EccD) = Gamma PEcH/neR with Gamma = 0 005T(sub e), providing current drive efficiency consistent with earlier experiments with a dependence on T(sub e), but fixed Z(sub eff) and trapped particle effects in these simulations
NTIS
Tokamak Devices; Electric Current

19990040951 Lawrence Livermore National Lab., Livermore, CA USA
Simulation of plasma flow in the DIII-D Tokamak
Porter, G.; Jun. 19, 1998; 7p; In English; 25th; Controlled fusion and plasma physics; Sponsored by European Physical Society, Switzerland
Report No.(s): DE98-058889; UCRL-JC-129497; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
The importance of the parallel flow of primary and impurity ions in the Scrape-Off layer (SOL) of divertor tokamaks has been recognized recently. Impurity accumulation on the closed flux surfaces is determined in part by their parallel flow in the SOL. In turn, the parallel transport of the impurity ions is determined in part by drag from the primary ion flow. Measurement of flow in the DIII-D tokamak has begun recently. We describe initial results of modeling plasma ion flow using the 2-D code UEDGE in this paper. We assume the impurity (carbon) arises from chemical and physical sputtering from the walls surrounding the DIII-D plasma. We include six charge states of carbon in our simulations. We make detailed compaison with a multitude of SOL plasma diagnostics, including the flow measurement, to verify the UEDGE physics model. We begin the paper with a brief description of the plasma and neutral models in the UEDGE code in Section 2. We then present initial results of flow simulations and compare them with experimental measurement in Section 3. We conclude with a discussion of the dominant physics processes identified in the modeling in Section 4.
NTIS
Tokamak Devices; Magnetohydrodynamic Flow; Simulation

19990040952 Department of Energy, Washington, DC USA
Measurements of near forward scattered laser light in a large ICF plasma
Moody, J. D.; Jun. 02, 1998; 21p; In English; 12th; High-temperature plasma diagnostics
Report No.(s): DE98-058770; UCRL-JC-129774; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
We describe an instrument which measures the angular spread and spectrum of near forward scattered laser light from a probe beam in a long scalelength laser-plasma. The instrument consists of a combination of time integrating and time resolving detectors which measure the scattered light amplitude over four orders of magnitude for a range of angles. These measurements allow us to study the beam spray resulting from various laser and plasma conditions and determine the density fluctuations associated with this beam spray.
NTIS
Laser Outputs; Inertial Confinement Fusion; Plasmas (Physics); Light Beams

19990040957 Department of Energy, Washington, DC USA
High-energy 4(omega) probe laser for laser-plasma experiments at nova
Glenzer, S.; Jun. 02, 1998; 19p; In English; 12th; High-temperature plasma diagnostics
Report No.(s): DE98-058748; UCRL-JC-129603; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
For the characterization of inertial confinement fusion plasmas we implemented a high-energy 4(omega) probe laser at the Nova laser facility. A total energy of > 50 Joules at 4(omega), a focal spot size of order 100 (micro) m, and a pointing accuracy of 100 (micro)m was demonstrated for target shots. This laser provides intensities of up to 3 x 10(exp 14)W cm(exp -2) and therefore fulfills high-power requirements for laser-plasma interaction experiments. The 4(omega) probe laser is now rou-

tinely used for Thomson scattering. Successful experiments were performed in gas-filled hohlraums at electron densities of n(sub e) > 2 X 10(exp 21)cm(exp -3) which represents the highest density plasma so far being diagnosed with Thomson scattering. NTIS

Laser Plasmas; Nova Laser System

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SOLID-STATE PHYSICS

Includes superconductivity. For related information, see also 33 Electronics and Electrical Engineering and 36 Lasers and Masers.

19990038372 Department of Energy, Office of Energy Research, Washington, DC USA

Use of Fourier reverse transforms in crystallographic phase refinement

Ringrose, S., Department of Energy, USA; Oct. 08, 1997; 109p; In English

Report No.(s): DE98-004647; IS-T-1780; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

A method for determination of crystal structures that have resisted solution through normal crystallographic methods has been developed. PHASER is a series of FORTRAN programs which aids in the structure solution of poorly phased electron density maps by refining the crystallographic phases. It facilitates the refinement of such poorly phased electron density maps for difficult structures which might otherwise not be solvable. The trial model, which serves as the starting point for the phase refinement, may be acquired by several routes such as direct methods or Patterson methods. Modifications are made to the reverse transform process based on several assumptions. First, the starting electron density map is modified based on the fact that physically the electron density map must be non-negative at all points. In practice a small positive cutoff is used. A reverse Fourier transform is computed based on the modified electron density map. Secondly, the authors assume that a better electron density map will result by using the observed magnitudes of the structure factors combined with the phases calculated in the reverse transform. After convergence has been reached, more atomic positions and less extraneous peaks are observed in the refined electron density map. The starting model need not be very large to achieve success with PHASER; successful phase refinement has been achieved with a starting model that consists of only 5% of the total scattering power of the full molecule. The second part of the thesis discusses three crystal structure determinations.

NTIS

Fourier Transformation; Crystallography; Refining

19990039088 Air Force Inst. of Tech., Wright-Patterson AFB, OH USA

Electrical Characterization of Ion-Implanted 4H-Silicon Carbide

Morath, Christian P.; Mar. 1999; 166p; In English

Report No.(s): AD-A361436; AFIT/GAP/ENP/99M-05; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche

Electrical characterization has been performed on ion-implanted p-type 4H-SiC to assess the activation efficiency and implantation-related damage recrystallization with the intention of developing an implantation/annealing scheme. Low doped (Na - Nd = 5 x 10(exp 15)/cu cm) epitaxial p-type layers grown by MOCVD were implanted with Al or B at doses ranging from 1 x 10(exp 13) to 1 x 10(exp 14)/sq cm at room temperature or 500 deg. C. The electrical technique of Temperature Dependent Hall Effect (TDHE) indicated that Al and B act as shallow acceptors 4H-SiC with ionization energies of 252 and 285 meV, respectively. The highest activation efficiency for Al and B implanted samples was found to occur at anneal temperatures of 1650 deg C and 1550 deg C, respectively. The implantation dose resulting in the highest concentration for Al and B implantation was found to be 3 x 10(exp 13)/sq cm. An average peak mobility of 200 sq cm/ V s was found for an Al implanted sample; this is considerably higher than the average peak mobility for the B implanted samples, 100 sq cm/ V s. No significant gains in activation efficiency or mobility were evident with high temperature implantation compared to the room temperature implantation. Overall, Al implantation of 4H-SiC appears superior with regard to these properties compared to B implantation.

DTIC

Electrical Properties; Ion Implantation; Silicon Carbides; Temperature Dependence; Acceptor Materials

19990039182 Air Force Inst. of Tech., School of Engineering, Wright-Patterson AFB, OH USA

Band Structure Anisotropy in Semiconductor Quantum Wells

Novotny, Steven J.; Mar. 1999; 77p; In English

Report No.(s): AD-A361447; AFIT/ENP/GAP/99M-07; No Copyright; Avail: Issuing Activity (Defense Technical Information Center (DTIC)), Microfiche

The focus of this research is an investigation of energy band anisotropy in simple quantum well structures. This anisotropy results from the asymmetry of the periodic potential within the crystal lattice. For sufficiently high doping levels, band structure anisotropy is expected to play an important role in the evaluation of the electronic and optical properties of the quantum well structures. The analysis uses a model based on a 6 x 6 Luttinger-Kohn k.p approach for bulk material valence band structure together with the Envelope Function Approximation. The model is used to analyze Si/SiGe, AlGaAs/GaAs, and GaAs/InGaAs quantum wells for the 001 and the 110 growth directions. The resulting band structures show significant anisotropy for materials grown in both the 110 and 001 directions. In all cases the materials grown in the 110 direction show a more pronounced anisotropy than the materials grown in the 001 directions. For the 001 growth directions, the band structures were effectively isotropic for values of k-parallel less than 0.4 inverse angstrom for Si/SiGe, 0.6 inverse angstrom for GaAs/AlGaAs, and 0.5 inverse angstrom for InGaAs/GaAs.
DTIC
Band Structure of Solids; Anisotropy; Semiconductors (Materials); Quantum Wells; Energy Bands

19990039582 Department of Energy, Office of Energy Research, Washington, DC USA
Atomic-scale structures in complex solids by Z-contrast STEM and first- principles theory
Pennycook, S. J., Department of Energy, USA; Pantelides, S. T., Department of Energy, USA; Maiti, A., Department of Energy, USA; Chisholm, M. F., Department of Energy, USA; Yan, Y., Department of Energy, USA; Feb. 28, 1998; 5p; In English; 14th; Electron Microscopy, USA
Report No.(s): DE98-005720; ORNL/CP-97024; CONF-980808; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Modern high-resolution scanning transmission electron microscopes are capable of forming electron probes below 2(angstrom), sufficiently small to allow an atomic resolution Z-contrast image to be formed from many materials. Such images, formed with a high angle annular detector, are incoherent in nature, and can be described as a convolution of the probe intensity profile with an object function peaked sharply at the atomic sites. Unlike phase contrast microscopy, there is no phase problem associated with an incoherent image, and direct inversion to the projected atomic structure is possible. A quantitative method for structure retrieval is maximum entropy analysis, although under Scherzer incoherent conditions the probe tails are small, and peaks in the image intensity correspond closely to atomic positions. In such cases, an intuitive structure determination may be possible. Electron energy loss spectroscopy (EELS) may also be performed simultaneously, using the Z- contrast image to position the probe over selected atomic columns, providing complementary information on composition and electronic structure. On the theoretical side, present-day computers are now capable of electronic structure calculations that can be used to determine the preferred atomic arrangements in complex systems. Both first-principles and semiempirical approaches have been developed with complementary capabilities. Here the authors present several examples where a synergistic approach combining Z-contrast STEM, spatially resolved EELS and theoretical results have led to the elucidation of complex atomic structures. The ability to determine atomic structures experimentally to high accuracy provides both a perfect starting point for theoretical calculations and an ideal test of theoretical predictions. Theoretical studies can explore the new dimensions of time and energy. This combined approach leads to a detailed and comprehensive picture of complex atomistic mechanisms.
NTIS
Crystal Structure; Scale Models; Electronic Structure; Images; High Resolution; Energy Dissipation; Electron Energy; Composition (Property); Atomic Structure

19990040184 Massachusetts Inst. of Tech., Lincoln Lab., Lexington, MA USA
Solid State Research ***Quarterly Report, 1 Aug. - 31 Oct. 1998***
Shaver, David C.; Mar. 23, 1999; 64p; In English
Contract(s)/Grant(s): F19628-95-C-0002
Report No.(s): AD-A361196; TR-1998:4; ESC/ENCB-TR-98-044; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

This report covers in detail the research work of the Solid State Division at Lincoln Laboratory for the period 1 August through 31 October 1998. The topics covered are Quantum Electronics, Electro-optical Materials and Devices, Submicrometer Technology, Biosensor and Molecular Technologies, Microelectronics, Analog Device Technology, and Advanced Silicon Technology. Funding is provided by several DoD organizations - including the Air Force, Army, BMDO, DARPA, Navy, NSA, and OSD-and also by the DOE, NASA, and NIST.
DTIC
Solid State Physics; Optoelectronic Devices; Microelectronics; Bioinstrumentation; Quantum Electronics

19990040255 NASA Lewis Research Center, Cleveland, OH USA

Equiaxed Dendritic Solidification Experiment (EDSE)

Beckermann, C., Iowa Univ., USA; Steinbach, I., Aachener Centrum fuer Erstarrung unter Schwerelosigkeit e.V., Germany; Karma, A., Northeastern Univ., USA; deGroh, H. C., III, NASA Lewis Research Center, USA; NASA Microgravity Materials Science Conference; February 1999, pp. 83-88; In English; See also 19990040241; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

The objective of the research is to quantitatively determine and understand the fundamental mechanisms that control the microstructural evolution during solidification of an assemblage of equiaxed dendritic crystals. A microgravity experiment will be conducted to obtain benchmark data on the transient growth and interaction of up to four equiaxed crystals of a pure and transparent metal analog (succinonitrile, SCN) under strictly diffusion dominated conditions. of interest in the experiment are the transient evolution of the primary and secondary dendrite tip speeds, the dendrite morphology (i.e., tip radii, branch spacings, etc.) and solid fraction, the tip selection criterion, and the temperature field in the melt for a range of initial supercoolings and, thus, interaction ”strengths” between the crystals. The experiment thus extends the microgravity measurements of Glicksman and coworkers for steady growth of a single dendrite [Isothermal Dendritic Growth Experiment (IDGE), first flown on USMP-2] to a case where growth transients are introduced due to thermal interactions between neighboring dendrites - a situation more close to actual casting conditions. Corresponding earth-based experiments will be conducted to ascertain the influence of melt convection. The experiments are supported by a variety of analytical models and numerical simulations. The data will primarily be used to develop and test theories of transient dendritic growth and the solidification of multiple interacting equiaxed crystals in a supercooled melt.

Derived from text

Spaceborne Experiments; Space Processing; Microgravity; Melts (Crystal Growth); Dendritic Crystals; Solidification; Microstructure; Supercooling; Crystal Growth

19990040258 Massachusetts Inst. of Tech., Dept. of Chemical Engineering, CamBridge, MA USA

Application of Parallel Computing for Two- and Three-Dimensional Modeling of Bulk Crystal Growth and Microstructure Formation

Brown, Robert A., Massachusetts Inst. of Tech., USA; NASA Microgravity Materials Science Conference; February 1999, pp. 105-106; In English; See also 19990040241; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

The quality of metal oxide and semiconductor crystals grown from the melt depends fundamentally on heat, mass, and species transport in the melt and crystal and on the interactions of these fields with the formation of microstructure, microdefects, dislocations, and voids in the grown crystal. Modeling of these individual processes for understanding their complex interactions is essential to the successful growth of crystals in a microgravity environment and to the interpretation of experiments from ground-based and microgravity research. The complexity of mathematical models of these phenomena makes numerical simulation essential. The goal of this project is to develop modern numerical simulation methods for calculation of complex models of transport processes in crystal growth and of microdefect formation using modern scaleable parallel computing. Research to date has focused on the development of numerical methods for two types of mathematical models: development of parallel numerical algorithms for solutions of complex models of transport processes in material processing, and the development of algorithms for computation of mesoscale microstructure in materials processing. In parallel, we have continued our investigation of the dynamics of small-scale crystal growth systems of interest in microgravity applications, especially of the thermal-capillary and hydrodynamic dynamics of small-scale floating zone systems. This later research will not be discussed in this report.

Derived from text

Parallel Processing (Computers); Three Dimensional Models; Mathematical Models; Computerized Simulation; Melts (Crystal Growth); Crystal Growth; Transport Theory

19990040260 Illinois Univ., Chicago, IL USA

Three-Dimensional Velocity Field Characterization in a Bridgman Apparatus: Technique Development and Effect Analysis

Slepicka, James S., Illinois Univ., USA; Ge, Yi, Illinois Univ., USA; Cha, Soyoung Stephen, Illinois Univ., USA; NASA Microgravity Materials Science Conference; February 1999, pp. 109-113; In English; See also 19990040241; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

The integrity of crystal structures is strongly influenced by the existence of thermally-induced flows as well as local nucleation particles and their growth in the melt, which may act in a detrimental manner. In both ground-based and microgravity experiments, these physical properties that involve three-dimensional (3-D) fluid or particle motions need to be characterized to identify their effects on material processing. In spite of the efforts to alleviate detrimental flow problems, their influence cannot be completely eliminated. Such 3-D flows make instantaneous gross-field evaluation practically impossible with existing point probes.

Two-dimensional two-component measurement methods such as particle imaging velocimetry (PIV) can provide valuable information but still pose limitations in investigating 3-D fields. Consequently, providing means for detecting 3-D three-component (3-C) velocity or particle fields and characterizing pertinent solidification parameters is very important for crystal growth experiments in optimizing production parameters. It is also vital to validation and improvement of numerical modeling for material processing. In the effort to overcome the intrinsic limitations of the current techniques, two complementary optical techniques have been developed and tested for measurement of 3-D 3-C particle or flow motions, which reflect the peculiar aspects of restricting experimental conditions in crystal growth and material processing. One, termed Holographic Diffraction Image Velocimetry (HDIV), utilizes double-reference-beam off-axis holographic recording and reconstruction of two independent time-sequence images of a particle field. The other, called Stereoscopic Imaging Velocimetry (SIV), is based on dual solid-state camera observation from different vantage points. These two techniques are believed to meet a broad range of experimental requirements, being complementary with respective strengths and limitations. The HDIV technique offers velocity extraction of an extended area with high spatial resolution and dynamic range from a single observation direction but it does not provide a real-time capability. It is also complex in setup. In contrast, the SIV technique is appropriate for observing a restricted area only with limited resolution and dynamic range but it allows continual near-real-time velocity monitoring. Its experimental configuration is also simple, including hardware and software. In both of these techniques, the illumination beam is not restricted to any specific plane of focus as in PIV, and can be reasonably thick to provide true volume illumination since the images are recorded in three-dimensions. A description of the methods and experimental results, conclusions and three figures detailing: (1) Measured out-of-plane displacements from a rotated plane particle field; (2) In-plane velocity components for a typical plane in the flow around a failing sphere; and (3) Flow field with 600 particles are presented.
Derived from text
Imaging Techniques; Velocity Measurement; Velocity Distribution; Three Dimensional Motion; Bridgman Method; Crystal Structure; Flow Distribution; Crystal Growth

19990040267 Missouri Univ., Ceramic Engineering Dept., Rolla, MO USA
Kinetics of Nucleation and Crystal Growth in Glass Forming Melts in Microgravity
Day, Delbert E., Missouri Univ., USA; Ray, Chandra S., Missouri Univ., USA; NASA Microgravity Materials Science Conference; February 1999, pp. 153-158; In English; See also 19990040241
Contract(s)/Grant(s): NAG8-1465; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

The following list summarizes the most important results that have been consistently reported for glass forming melts in microgravity: (1) Glass formation is enhanced for melts prepared in space; (2) Glasses prepared in microgravity are more chemically homogeneous and contain fewer and smaller chemically heterogeneous regions than identical glasses prepared on earth; (3) Heterogeneities that are deliberately introduced such as Pt particles are more uniformly distributed in a glass melted in space than in a glass melted on earth; (4) Glasses prepared in microgravity are more resistant to crystallization and have a higher mechanical strength and threshold energy for radiation damage; and (5) Glasses crystallized in space have a different microstructure, finer grains more uniformly distributed, than equivalent samples crystallized on earth. The preceding results are not only scientifically interesting, but they have considerable practical implications. These results suggest that the microgravity environment is advantageous for developing new and improved glasses and glass-ceramics that are difficult to prepare on earth. However, there is no suitable explanation at this time for why a glass melted in microgravity will be more chemically homogeneous and more resistant to crystallization than a glass melted on earth. A fundamental investigation of melt homogenization, nucleation, and crystal growth processes in glass forming melts in microgravity is important to understanding these consistently observed, but yet unexplained results. This is the objective of the present research. A lithium disilicate (Li2O.2SiO2) glass will be used for this investigation, since it is a well studied system, and the relevant thermodynamic and kinetic parameters for nucleation and crystal growth at 1-g are available. The results from this research are expected to improve our present understanding of the fundamental mechanism of nucleation and crystal growth in melts and liquids, and to lead improvements in glass processing technology on earth, with the potential for creating new high performance glasses and glass-ceramics.
Derived from text
Spaceborne Experiments; Space Processing; Microgravity; Gravitational Effects; Silica Glass; Nucleation; Crystal Growth; Melts (Crystal Growth); Solidification; Reaction Kinetics; Crystallization

19990040268 Minnesota Univ., Dept. of Chemical Engineering and Materials Science, Minneapolis, MN USA
Atomistic Simulations of Cadmium Telluride: Toward Understanding the Benefits of Microgravity Crystal Growth
Derby, J. J., Minnesota Univ., USA; Chelikowsky, J. R., Minnesota Univ., USA; NASA Microgravity Materials Science Conference; February 1999, pp. 159-160; In English; See also 19990040241; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Progress in crystal growth on earth or in space will depend on a more fundamental understanding of the important coupling between atomistic-scale processes which control the properties of grown crystalline material and the macroscopic transport conditions imposed by the growth system. Our long-term goal is to understand the mechanisms which influence crystal quality through the hierarchy of length and time scales relevant to these atomistic-scale and macro-scale processes. The immediate goal of the research summarized here is to employ atomistic simulation to understand better the melt growth of cadmium telluride (CdTe) and its alloy cadmium zinc telluride (CdZnTe). These materials are employed in a variety of technologically important electronic and electro-optical devices; however, the growth of high-quality, large-area single crystal substrate has proven to be extremely difficult under terrestrial conditions. We seek to obtain a more fundamental understanding of the properties of cadmium telluride so that the physical mechanisms responsible for growth can be elucidated. A secondary objective of our work is the prediction of high-temperature thermophysical properties of liquid and solid CdTe.
Derived from text
Spaceborne Experiments; Space Processing; Microgravity; Gravitational Effects; Cadmium Tellurides; Crystal Growth; Single Crystals; Melts (Crystal Growth); Atomic Mobilities; Computerized Simulation

19990040269 Minnesota Univ., Dept. of Chemical Engineering and Materials Science, Minneapolis, MN USA
Theoretical Analysis of 3D, Transient Convection and Segregation in Microgravity Bridgman Crystal Growth
Derby, J. J., Minnesota Univ., USA; Yeckel, A., Minnesota Univ., USA; NASA Microgravity Materials Science Conference; February 1999, pp. 161-162; In English; See also 19990040241; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Key to the advancement of crystal growth processing is a better understanding of the dominant influence of buoyancy-driven convection on segregation and morphological stability during crystal growth on earth. Since these effects in turn play a critical role in establishing the structure and properties of grown materials, considerable interest has developed for their study by use of the microgravity environment provided by space flight. However, space flight experiments are still subject to accelerations that rapidly vary in magnitude and direction, and such variations complicate experiments by the introduction of significant transient and three-dimensional effects. We propose to develop rigorous process models that account for such three-dimensional, transient phenomena during melt crystal growth under microgravity conditions. With this model, we will perform fundamental studies of transient acceleration and g-jitter effects - significant advances in the understanding of segregation phenomena are to be expected. In addition, there is an immediate and continuing need of the microgravity flight experiment program for three-dimensional growth models coupled with realistic heat transfer models that describe current NASA flight furnaces, such as the Advanced Automated Directional Solidification Furnace (AADSF) and Crystal Growth Furnace (CGF). The codes developed here will enable the unambiguous interpretation of flight experiments, and will, perhaps even more importantly, provide a tool to design the conditions needed in future flight experiments to best study the effects of microgravity on segregation theory.
Derived from text
Spaceborne Experiments; Space Processing; Microgravity; Gravitational Effects; Directional Solidification (Crystals); Crystal Growth; Three Dimensional Models; Vibration Effects; Finite Element Method; Momentum Transfer; Transport Theory

19990040271 State Univ. of New York, Dept. of Materials Science and Engineering, Stony Brook, NY USA
Combined Synchrotron White Beam X-Ray Topography and High Resolution Triple Axis X-Ray Diffraction Characterization and Analysis of Crystals Grown in Microgravity and Ground-Based Environments
Dudley, M., State Univ. of New York, USA; Matyi, R. J., Wisconsin Univ., USA; NASA Microgravity Materials Science Conference; February 1999, pp. 169-174; In English; See also 19990040241; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

The objective of the research proposed here is to carry out detailed studies of defect and general distortion distributions in crystals grown in both microgravity and ground based environments (e.g. using modified Bridgman, Vapor Transport or Traveling Heater Method techniques) using a combination of synchrotron white beam X-ray topography (SWBXT) and high resolution triple crystal X-ray diffractometry (HRTXD). This unique combination of techniques is expected to reveal detailed differences between crystals grown in these two different environments and to enable meaningful assessment to be made of the influence of a microgravity environment on various aspects of the quality of crystals grown therein. SWBXT and HRTXD are complementary analytical techniques which are most sensitive and useful at contrasting ends of the ”scale” of defect densities in crystals. by applying both techniques to the same crystals, it will be possible to provide detailed and quantitative assessments of the defect structure from 169 regions that range from highly perfect (where SWBXT is expected to be the superior characterization tool) to highly imperfect (where HRTXD should be the superior method). This unified and continuous view of the defect structure should lead to valuable insights into the effect of growth conditions on the defect generation process. The proposed research program will draw upon the extensive experience that has been gained at the State University of New York - Stony Brook and University of Wisconsin - Madison in the analysis of defects in semiconductors using advanced methods of X-ray diffraction. Prof. Michael Dudley of

SUNY - Stony Brook has worked closely with the crystal growth community at NASA's Marshall Space Flight Center (MSFC) in applying methods of SWBXT to numerous semiconductor crystals grown both on earth and in microgravity. His counterpart, Prof. Richard Matyi of UW - Madison, has been actively engaged in demonstrating the capabilities of HRTXD to a variety of semiconductor materials. by combining these complementary techniques it should be possible to obtain a deeper understanding of the process of defect generation than would be possible with either technique alone, or perhaps by any structural probe. The significance of the research described here is that it will directly determine the influence of a microgravity environment on the detailed defect and distortion distribution in crystals produced in flight experiments, and will enable direct comparison to be drawn with crystals produced in ground based experiments. Confirmation has already been obtained that effects resulting from the limited flight times available for microgravity crystal growth experiments can exert control over the microstructure of the crystals grown, potentially detracting from the intended assessment of the influence of the magnitude of the gravity vector on these processes. Determination of the influence of cooling rate on the defect microstructure of crystals is crucial for selection of experimental conditions under which the effects of the gravity vector on crystal growth quality can be usefully investigated. Once such selection has been optimized, differences in microstructure observed in microgravity grown crystals may be safely attributed to the influence of the gravity vector and not to artifacts related to compressed growth schedules.
Derived from text
Spaceborne Experiments; Space Processing; Microgravity; Gravitational Effects; Crystal Growth; Crystal Defects; Crystallography; Cooling

19990040276 Alabama Univ., Center for Microgravity and Materials Research, Huntsville, AL USA
Investigation of Vibrational Control of the Bridgman Crystal Growth Technique
Fedoseyev, Alexandre, Alabama Univ., USA; NASA Microgravity Materials Science Conference; February 1999, pp. 199-204; In English; See also 19990040241; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

The objective of this ongoing research is to characterize and quantify using vibrational control of convective flows and, thus, to provide defined convective contributions to both heat and mass transport of Bridgman crystal growth. It has been recognized that oscillatory, or pulsatile, flow significantly alters the transfer of mass, heat and momentum in fluid systems. Our research involves a fundamental theoretical investigation, facilitated by numerical analysis, complemented by ongoing and planned experimental flow visualizations and crystal growth studies at the Stanford University and the General Physics Institute. Research project objectives are to: (1) conduct a parametric theoretical and numerical investigation of vibro-convective buoyancy-driven flow in differentially heated cylindrical containers; (2) investigate buoyant vibro-convective transport regimes in Bridgman-type systems with a focus on the use of vibration to suppress, or control, convection in order to achieve transport control during crystal growth; (3) assess the feasibility of vibro-convective control as a means of offsetting "g-jitter" effects under microgravity conditions; and (4) exchange information with the experimental group of Prof. E. Zharikov at the General Physics Institute (GPI) of the Russian Academy of Science and Prof. R. Feigelson at Stanford University who are undertaking a complementary experimental program. Significance and justification for microgravity research, theoretical and numerical modeling, and significant results of the investigation are presented.
Derived from text
Bridgman Method; Convection; Convective Flow; Crystal Growth; Vibration Damping; Microgravity

19990040277 Stanford Univ., Stanford, CA USA
Investigation of the Crystal Growth of Dielectric Materials by the Bridgman Technique Using Vibrational Control
Feigelson, Robert S., Stanford Univ., USA; Zharikov, Evgenii, Academy of Sciences (USSR), USSR; NASA Microgravity Materials Science Conference; February 1999, pp. 205-211; In English; See also 19990040241; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

The principal goal of this ground-based program, which started in February 1998, is to investigate the influence of low frequency vibrations on the fluid flow and quality of dielectric oxide crystals grown by the vertical Bridgman method. This experimental program, a collaborative effort between Stanford University and the General Physics Institute of the Russian Academy of Sciences in Moscow , includes a strong emphasis on both physical modeling and the growth of some technologically important materials. It is in close collaboration with the theoretical and numerical investigations of A. Fedoseyev and I. Alexander in another NASA sponsored program. This latter program involves a study of vibro-convective buoyancy-driven flows in cylindrical configurations with the expectation of being able to use vibrational flows to control buoyancy driven fluid transport to off-set the effect of "g-jitter" during microgravity Bridgman crystal growth. These two programs taken together, will lead to a new parametric control variable which can be used to either suppress or control convection, and thereby heat and mass transport during Bridgman crystal growth. It is expected to be effective in either a terrestrial or space environment. The experimental program is designed to verify and refine the results of the predictions made in the theoretical program, lead to the design of vibration controlled growth

systems which can be adapted to NASA flight ready crystal growth furnaces, and provide recommendations for the use of this vibrational technology in space growth experiments. In this work, the hydrodynamic flow patterns for variously shaped vibrating bodies, various heating conditions, and with an appropriate temperature distribution in the liquid phase (both the model and crystallizing systems) were studied. The vibrating body, its location to the crystallization front, the geometrical parameters associated with the area of the ampoule walls and the vibrating body, and the height of the liquid column were found to have a considerable influence on the vibroconvective flow patterns and temperature distributions in the liquid phase. Vibroconvective flows greatly influenced the position and shape of the solid-liquid interface in real crystallizing systems.
Derived from text
Bridgman Method; Crystal Growth; Crystallization; Fluid Flow; Vibration; Microgravity

19990040300 Case Western Reserve Univ., Cleveland, OH USA
Dislocation Formation During Growth of Semiconductor Crystals
Kaforey, Monica L., Case Western Reserve Univ., USA; Matthiesen, David H., Case Western Reserve Univ., USA; Chait, Arnon, Case Western Reserve Univ., USA; NASA Microgravity Materials Science Conference; February 1999, pp. 351-357; In English; See also 19990040241; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

In the ongoing efforts to produce higher quality semiconductor materials, there is a continuous search for ways to consistently make materials with fewer defects. Thus, improvements in the understanding of how and why defects form would be extremely beneficial. This research examined one of the factors believed to affect dislocation formation during the growth of semiconductor crystals. During directional solidification of semiconductor crystals, dislocations propagate from the existing crystal to the growing crystal at the melt/solid interface and from the solid/crucible surface into the growing crystal. Modeling efforts have shown that the interaction between the crucible wall and the sample in the region of the melt/solid interface has a significant effect on dislocation formation. Previous experimentation in microgravity has shown that when the melt is not in contact with the wall of the crucible, the resulting crystal will have a lower dislocation density. It is hypothesized that the increased ability of the crystal to relieve stresses is responsible for the lower dislocation density. The research done under the current ground-based funding will help to prepare for future space flight investigations of the effect of forced contact versus detachment of the melt from the crucible wall on dislocation structure during directional solidification of semiconductor crystals. The current research also involved characterization of a spring that would be necessary for maintaining melt/crucible contact during future flight experimentation.
Author
Microgravity; Gravitational Effects; Crystal Dislocations; Crystal Growth; Directional Solidification (Crystals); Semiconductors (Materials); Shear Stress

19990040311 NASA Marshall Space Flight Center, Huntsville, AL USA
Crystal Growth of II-VI Semiconducting Alloys by Directional Solidification
Lehoczky, Sandor L., NASA Marshall Space Flight Center, USA; Szofran, Frank R., NASA Marshall Space Flight Center, USA; Su, Ching-Hua, NASA Marshall Space Flight Center, USA; Cobb, Sharon D., NASA Marshall Space Flight Center, USA; Scripa, Rosalia A., Alabama Univ., USA; Sha, Yi-Gao, Universities Space Research Association, USA; NASA Microgravity Materials Science Conference; February 1999, pp. 411-413; In English; See also 19990040241; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

This research study is investigating the effects of a microgravity environment during the crystal growth of selected II-VI semiconducting alloys on their compositional, metallurgical, electrical and optical properties. The on-going work includes both Bridgman-Stockbarger and solvent growth methods, as well as growth in a magnetic field. The materials investigated are II-VI, Hg(1-x)Zn(x)Te, and Hg(1-x)Zn(x)Se, where x is between 0 and 1 inclusive, with particular emphasis on x-values appropriate for infrared detection and imaging in the 5 to 30 micron wavelength region. Wide separation between the liquidus and solidus of the phase diagrams with consequent segregation during solidification and problems associated with the high volatility of one of the components (Hg), make the preparation of homogeneous, high-quality, bulk crystals of the alloys an extremely difficult nearly an impossible task in a gravitational environment. The three-fold objectives of the on-going investigation are as follows: (1) to determine the relative contributions of gravitationally-driven fluid flows to the compositional redistribution observed during the unidirectional crystal growth of selected semiconducting solid solution alloys having large separation between the liquidus and solidus of the constitutional phase diagram; (2) to ascertain the potential role of irregular fluid flows and hydrostatic pressure effects in generation of extended crystal defects and second-phase inclusions in the crystals; and, (3) to obtain a limited amount of ”high quality” materials needed for bulk crystal property characterizations and for the fabrication of various device structures

needed to establish ultimate material performance limits. The flight portion of the study was to be accomplished by performing growth experiments using the Crystal Growth Furnace (CGF) manifested to fly on various Spacelab missions.
Derived from text
Spaceborne Experiments; Space Processing; Microgravity; Gravitational Effects; Directional Solidification (Crystals); Crystal Growth; Solid Solutions; Semiconductors (Materials); Hydrostatic Pressure; Pressure Effects; Crystal Structure; Fluid Flow; Crystallization

19990040312 NASA Marshall Space Flight Center, Huntsville, AL USA
Growth of Solid Solution Single Crystals
Lehoczky, Sandor L., NASA Marshall Space Flight Center, USA; Szofran, Frank R., NASA Marshall Space Flight Center, USA; Gillies, Donald C., NASA Marshall Space Flight Center, USA; Watring, Dale A., NASA Marshall Space Flight Center, USA; NASA Microgravity Materials Science Conference; February 1999, pp. 415-417; In English; See also 19990040241; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

The objective of the study is to establish the effects of processing semiconducting, solid solution, single crystals in a microgravity environment on the metallurgical, compositional, electrical, and optical characteristics of the crystals. The alloy system being investigated is the solid solution semiconductor Hg(1-x)Cd(x)Te, with x-values appropriate for infrared detector applications in the 8 to 14 mm wavelength region. Both melt and Te-solvent growth are being performed. The study consists of an extensive ground-based experimental and theoretical research effort followed by flight experimentation where appropriate. The ground-based portion of the investigation also includes the evaluation of the relative effectiveness of stabilizing techniques, such as applied magnetic fields, for suppressing convective flow during the melt growth of the crystals.
Derived from text
Microgravity; Gravitational Effects; Solid Solutions; Magnetic Fields; Melts (Crystal Growth); Semiconductors (Materials); Single Crystals; Mercury Alloys; Crystal Growth

19990040319 Wisconsin Univ., Madison, WI USA
High Resolution Triple Axis X-Ray Diffraction Analysis of II-VI Semiconductor Crystals
Volz, H. M., Wisconsin Univ., USA; Matyi, R. J., Wisconsin Univ., USA; NASA Microgravity Materials Science Conference; February 1999, pp. 457-462; In English; See also 19990040241
Contract(s)/Grant(s): NCC8-48; USRA-3537-08; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

The objective of this research program is to develop methods of structural analysis based on high resolution triple axis X-ray diffractometry (HRTXD) and to carry out detailed studies of defect distributions in crystals grown in both microgravity and ground-based environments. HRTXD represents a modification of the widely used double axis X-ray rocking curve method for the characterization of grown-in defects in nearly perfect crystals. In a double axis rocking curve experiment, the sample is illuminated by a monochromatic X-ray beam and the diffracted intensity is recorded by a fixed, wide-open detector. The intensity diffracted by the sample is then monitored as the sample is rotated through the Bragg reflection condition. The breadth of the peak, which is often reported as the full angular width at half the maximum intensity (FWHM), is used as an indicator of the amount of defects in the sample. This work has shown that high resolution triple axis X-ray diffraction is an effective tool for characterizing the defect structure in semiconductor crystals, particularly at high defect densities. Additionally, the technique is complimentary to X-ray topography for defect characterization in crystals.
Derived from text
X Ray Diffraction; Semiconductors (Materials); Structural Analysis; Crystal Structure; Crystal Defects

19990040323 University of Southern California, Dept. of Aerospace Engineering, Los Angeles, CA USA
Potential Flow Interactions With Directional Solidification
Buddhavarapu, Sudhir S., University of Southern California, USA; Meiburg, Eckart, University of Southern California, USA; NASA Microgravity Materials Science Conference; February 1999, pp. 481-486; In English; See also 19990040241
Contract(s)/Grant(s): NAG3-1619; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

The effect of convective melt motion on the growth of morphological instabilities in crystal growth has been the focus of many studies in the past decade. While most of the efforts have been directed towards investigating the linear stability aspects, relatively little attention has been devoted to experimental and numerical studies. In a pure morphological case, when there is no flow, morphological changes in the solid-liquid interface are governed by heat conduction and solute distribution. Under the influence of a convective motion, both heat and solute are redistributed, thereby affecting the intrinsic morphological phenomenon. The overall effect of the convective motion could be either stabilizing or destabilizing. Recent investigations have predicted stabilization by a flow parallel to the interface. In the case of non-parallel flows, e.g., stagnation point flow, Brattkus and Davis have found a new

flow-induced morphological instability that occurs at long wavelengths and also consists of waves propagating against the flow. Other studies have addressed the nonlinear aspects (Konstantinos and Brown, Wollkind and Segel)). In contrast to the earlier studies, our present investigation focuses on the effects of the potential flow fields typically encountered in Hele-Shaw cells. Such a Hele-Shaw cell can simulate a gravity-free environment in the sense that buoyancy-driven convection is largely suppressed, and hence negligible. Our interest lies both in analyzing the linear stability of the solidification process in the presence of potential flow fields, as well as in performing high-accuracy nonlinear simulations. Linear stability analysis can be performed for the flow configuration mentioned above. It is observed that a parallel potential flow is stabilizing and gives rise to waves traveling downstream. We have built a highly accurate numerical scheme which is validated at small amplitudes by comparing with the analytically predicted results for the pure morphological case. We have been able to observe nonlinear effects at larger times. Preliminary results for the case when flow is imposed also provide good validation at small amplitudes.
Derived from text
Crystal Growth; Directional Solidification (Crystals); Flow Distribution; Melts (Crystal Growth); Morphology; Potential Flow; Stability; Microgravity

19990040326 Rensselaer Polytechnic Inst., Troy, NY USA
Space-and Ground-Based Crystal Growth Using a Submerged Baffle
Ostrogorsky, A. G., Rensselaer Polytechnic Inst., USA; Dutta, P. S., Rensselaer Polytechnic Inst., USA; Marin, C., Rensselaer Polytechnic Inst., USA; Vogel, M., Rensselaer Polytechnic Inst., USA; Pegnier, T., Rensselaer Polytechnic Inst., USA; Duffar, Thierry, Nuclear Research Center of Grenoble, France; NASA Microgravity Materials Science Conference; February 1999, pp. 495-500; In English; See also 19990040241; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

The composition of semiconductor crystals produced in space by conventional melt-growth processes is affected by minute levels of residual micro-acceleration which causes natural convection. The residual acceleration has random magnitude, direction and frequency. Therefore, the velocity field in the melt is a priori unpredictable. Virtually all crystal growth experiments conducted in microgravity have shown evidence of convective interference with segregation. Most melt growth experiments conducted in space do not yield the expected steady-state uniform composition. No composition has been reproduced. Low growth rate R and segregation coefficient k make composition particularly sensitive to residual micro-acceleration. There is no accepted formula for calculating the growth parameters in space. The Submerged Heater Method (SHM) for directional solidification significantly reduces the level of buoyancy-driven convection. The main feature of this method is a disk-shaped baffle which acts as a partition, creating a small zone melt at the interface.
Derived from text
Spaceborne Experiments; Space Processing; Microgravity; Gravitational Effects; Convection; Crystal Growth; Directional Solidification (Crystals); Semiconductors (Materials); Submerging; Baffles

19990040328 Universities Space Research Association, Space Sciences Lab., Huntsville, AL USA
Investigation of Crystal Growth of Ternary II-VI and IV-VI Compounds by Physical Vapor Transport: Investigation of 'Contactless' Crystal Growth by Physical Vapor Transport and Convective Effects in Crystal Growth by Physical Vapor Transport
Palosz, W., Universities Space Research Association, USA; NASA Microgravity Materials Science Conference; February 1999, pp. 507-512; In English; See also 19990040241; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

The subject of the research is to investigate the process of crystal growth by Physical Vapor Transport of binary and ternary/doped II-VI and IV-VI materials. Our past efforts were focused on the following specific tasks: (1) investigation of the mass transport properties of Pb(Se,Te) by Physical Vapor Transport (PVT); (2) determination of the origin and magnitude of residual gases in crystal growth systems; (3) numerical modeling of thermal field in 'contactless' PVT (cPVT) configuration; and (4) characterization of crystals grown by cPVT technique. The investigation of PVT of Pb(Se, Te) lead to identification of some specific features of this crystal growth system which may be promising both for the material applications and for microgravity research. As a part of this study, an investigation of residual gases in sealed silica glass ampoules was conducted. The relevance of this study goes beyond Pb(Se,Te) or even PVT crystal growth technique, as a presence of residual gases has an apparent effect on phenomena occurring in other important crystal growth systems (formation of voids, detached solidification). Numerical modeling of cPVT was performed in order to better understand cPVT and to assess the relative importance of different experimental factors on the process. Crystal characterization done in this work showed the benefits of cPVT as a valuable crystal growth technique.
Derived from text
Crystal Growth; Vapor Deposition; Transport Properties; Residual Gas; Characterization; Ampoules; Mathematical Models

19990040341 NASA Lewis Research Center, Cleveland, OH USA

Flight Experiment to Study Double-Diffusive Instabilities in Silver-Doped Lead Bromide Crystals

Singh, N. B., Northrop Grumman Corp., USA; Rosch, W. R., Northrop Grumman Corp., USA; Suhre, D. R., Northrop Grumman Corp., USA; Coriell, S. R., National Inst. of Standards and Technology, USA; Duval, W. M. B., NASA Lewis Research Center, USA; NASA Microgravity Materials Science Conference; February 1999, pp. 581-587; In English; See also 19990040241; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

A detailed study on the effect of convection on crystal quality was carried out by growing lead bromide crystals in transparent Bridgman furnace. Direct observations were made on the solid-liquid interface and a new kind of instability was observed. This could be explained on the basis of toroidal flow in the AgBr-doped lead bromide sample. With the increasing translation velocity, the interface changed from flat to depressed, and then formed a cavity in the center of the growth tube. The crystal grown at the lowest thermal Rayleigh number showed the highest quality and crystal grown at the largest thermal Rayleigh number showed the worst quality. Numerical studies were carried out to provide a framework for interpreting the observed convective and morphological instabilities, and to determine the critical (limiting) concentration of dopant for a particular growth velocity and gravity level. Theoretical instability diagrams were compared with data obtained from the experimental studies. These studies provided basic data on convective behavior in doped lead bromide crystals grown by the commercially important Bridgman process.
Author

Bridgman Method; Doped Crystals; Crystal Growth; Morphology; Rayleigh Number; Convection; Microgravity

19990040345 NASA Marshall Space Flight Center, Huntsville, AL USA

Crystal Growth of ZnSe and Related Ternary Compound Semiconductors by Vapor Transport

Su, Ching-Hua, NASA Marshall Space Flight Center, USA; Brebrick, R. F., Marquette Univ., USA; Burger, A., Fisk Univ., USA; Dudley, M., State Univ. of New York, USA; Matyi, R., Wisconsin Univ., USA; Ramachandran, N., Universities Space Research Association, USA; Sha, Yi-Gao, Universities Space Research Association, USA; Volz, M., NASA Marshall Space Flight Center, USA; Shih, Hung-Dah, Texas Instruments, Inc., USA; NASA Microgravity Materials Science Conference; February 1999, pp. 605-610; In English; See also 19990040241; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

Complete and systematic ground-based experimental and theoretical analyses on the Physical Vapor Transport (PVT) of ZnSe and related ternary compound semiconductors have been performed. The analyses included thermodynamics, mass flux, heat treatment of starting material, crystal growth, partial pressure measurements, optical interferometry, chemical analyses, photoluminescence, microscopy, x-ray diffraction and topography as well as theoretical, analytical and numerical analyses. The experimental results showed the influence of gravity orientation on the characteristics of: (1) the morphology of the as-grown crystals as well as the as-grown surface morphology of ZnSe and Cr doped ZnSe crystals; (2) the distribution of impurities and defects in ZnSe grown crystals; and (3) the axial segregation in ZnSeTe grown crystals.
Derived from text

Chemical Analysis; Crystal Growth; Morphology; Semiconductors (Materials); Gravitational Effects; Doped Crystals; Defects; Microgravity; Mathematical Models

19990040346 NASA Marshall Space Flight Center, Huntsville, AL USA

Reduction of Defects in Germanium-Silicon

Szofran, Frank R., NASA Marshall Space Flight Center, USA; Benz, K. W., Freiburg Univ., Germany; Croell, Arne, Freiburg Univ., Germany; Dold, Peter, Freiburg Univ., Germany; Cobb, Sharon D., NASA Marshall Space Flight Center, USA; Volz, Martin P., NASA Marshall Space Flight Center, USA; Motakef, Shariar, Cape Simulations, Inc., USA; Walker, John S., Illinois Univ. at Urbana-Champaign, USA; NASA Microgravity Materials Science Conference; February 1999, pp. 611-616; In English; See also 19990040241; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

It is well established that crystals grown without contact with a container have far superior quality to otherwise similar crystals grown in direct contact with a container. In addition to float-zone processing, detached-Bridgman growth is often cited as a promising tool to improve crystal quality, without the limitations of float zoning. Detached growth has been found to occur quite often during microgravity experiments and considerable improvements of crystal quality have been reported for those cases. However, no thorough understanding of the process or quantitative assessment of the quality improvements exists so far. This project will determine the means to reproducibly grow Ge-Si alloys in the detached mode. Specific objectives include: (1) measurement of the relevant material parameters such as contact angle, growth angle, surface tension, and wetting behavior of the GeSi-melt on potential crucible materials; (2) determination of the mechanism of detached growth including the role of convection; (3) quantitative determination of the differences of defects and impurities among normal Bridgman, detached Bridgman, and floating zone (FZ) growth; (4) investigation of the influence of defined azimuthal or meridional flow due to rotating magnetic fields on the characteristics of detached growth; (5) control time-dependent Marangoni convection in the case of FZ-growth by the use of a rotating

magnetic field to examine the influence on the curvature of the solid-liquid interface and the heat and mass transport; and (6) grow high quality GeSi-single crystals with Si-concentration up to 10 at% and diameters up to 20 mm.
Derived from text
Gravitational Effects; Crystal Growth; Crystal Defects; Bridgman Method; Crystals; Defects; Float Zones; Impurities; Magnetic Fields; Microgravity

19990040354 Illinois Univ. at Urbana-Champaign, Urbana, IL USA
Modelling Crystal Growth With Magnetic Fields
Walker, J. S., Illinois Univ. at Urbana-Champaign, USA; NASA Microgravity Materials Science Conference; February 1999, pp. 661-666; In English; See also 19990040241; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

Models have been developed for the melt motion, heat transfer and mass transport of dopants for the Bridgman and floating zone processes with both steady and rotating magnetic fields. While most modellers obtain numerical solutions of the full Navier-Stokes and energy equations, we simplify these equations by eliminating certain terms which are negligible either for strong or weak magnetic fields. Our asymptotic solutions complement the numerical solutions of the full equations. The asymptotic solutions generally require a tiny fraction of the computer time or memory needed for full solutions. Thus, it is easy to treat a very large number of cases, which is important for process optimization. A good example is the buoyant convection driven by the g-jitters and other components of the residual accelerations for Bridgman crystal growth on a space vehicle. If the magnitude of the residual accelerations is less than 0.01 g(sub 0), and there is a steady axial magnetic field with a flux density of at least 0.2T, convective heat transfer and nonlinear inertial effects are very small--certainly less than 1%. Their neglect leads to linear equations, so that the solution for any history of accelerations with chaotic g-jitters, large spikes and a DC residual acceleration, and with any time-dependent orientation, is given by the superposition of three solutions for two different unidirectional accelerations. There is a vast difference between the simplicity of the six fundamental solutions, which capture all the physical phenomena, and the generation of numerical solutions of the full equations for each acceleration history measured during each experiment in space. On the other hand, the asymptotic assumptions are not appropriate for some important experiments, and the numerical solution of the full equations is necessary. Often the two approaches have their strengths and weaknesses in complementing parameter ranges. For example, the asymptotic method may give very accurate predictions for 0.5T, have a 5% error for 0.2T, and completely miss the key physics for 0.1T. On the other hand, the numerical solution of the full equations may give very accurate results for 0.1T with only slightly more computational resources than those required without a magnetic field. However, as the field strength is increased, boundary layers become very thin, which makes the numerical solution of the full equations progressively more computationally demanding. If good results can be obtained at 0.2T, then they can be used to validate the asymptotic approach which is certainly even better for stronger magnetic fields.
Derived from text
Mathematical Models; Float Zones; Bridgman Method; Crystal Growth; Magnetic Fields

19990040358 Rensselaer Polytechnic Inst., Dept. of Chemistry, Troy, NY USA
Defect Generation in CVT Grown Hg(1-x)Cd(x)Te Epitaxial Layers Under Normal and Reduced Gravity Conditions
Wiedemeier, H., Rensselaer Polytechnic Inst., USA; Ge, Y. R., Rensselaer Polytechnic Inst., USA; NASA Microgravity Materials Science Conference; February 1999, pp. 685-686; In English; See also 19990040241; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

The present investigation is concerned with the further elucidation of fluid flow interactions with deposition and growth processes. It is generally known that the compositional and structural uniformity of single crystalline layers are affected by the crystallographic orientation (off-orientation) and surface quality of the substrates, by the growth rate and temperature, and by annealing. The combined influences of these parameters on crystal growth and quality are most likely interrelated, yielding a rather complex mechanism of defect formation. The decoupling of the various origins of defect formation and their control represent major challenges in the field of crystal growth.
Derived from text
Vapor Deposition; Crystal Defects; Crystal Growth; Single Crystals; Microgravity; Gravitational Effects; Mercury Cadmium Tellurides; Convection

19990040359 Rensselaer Polytechnic Inst., Dept. of Chemistry, Troy, NY USA
Vapor Growth of Alloy-Type Semiconductor Crystals
Wiedmeier, H., Rensselaer Polytechnic Inst., USA; Ge, Y. R., Rensselaer Polytechnic Inst., USA; Hutchins, M. A., Rensselaer Polytechnic Inst., USA; NASA Microgravity Materials Science Conference; February 1999, pp. 687-688; In English; See also 19990040241; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche; Abstract Only; Abstract Only

The advantages of vapor phase techniques are very useful for the growth of high-quality Hg(1-x)Cd(x)Te bulk crystals and epitaxial layers. Because of the greatly different vapor pressures of the constituents of Hg(1-x)Cd(x)Te, the chemical vapor transport method is employed, allowing the use of a single source material of predetermined composition in a closed container. This technique is particularly suitable for crystal growth under space flight conditions. Extensive ground-based studies of the bulk growth and heteroepitaxy of Hg(1-x)Cd(x)Te on CdTe by CVT revealed the sensitivity of this complex, ternary, alloy-type growth system to possibly even minute convective effects under vertical, stabilizing conditions. They also demonstrated the inherent transient properties of this heterojunction system. The influences of the initial compositional and structural microhomogeneity on the electrical properties of layers are observed. These observations strongly suggested measurable effects of microgravity on vapor phase crystal growth of this material. The growth of Hg(1-x)Cd(x)Te epitaxial layers by chemical vapor transport on (100) CdTe during the First USA Microgravity Laboratory (USML- 1) (6.4 and 8.1 hr growth) mission showed significant improvements in the crystallinity of the substrate/layer interface, of the epitaxial layer and of the surface morphology relative to ground samples. These observations indicated the effects of residual convective flow at or near the interface on crystal growth on ground. The morphological improvements of the space-grown layers are reflected in the considerably increased carrier mobilities. In order to further elucidate the effects of fluid flow on deposition and layer growth during the transient period of this system, the Second USA Microgravity Laboratory (USML-2) mission experiments were performed for shorter growth periods (1.5 and 2.5 hr growth). This required further ground-based experiments concerning the necessary temperature-time-line conditions. The emphasis in these studies was on the observation of microgravity effects on layer growth under transient, non-steady-state conditions. The objectives included the observation of the coalescence of three-dimensional islands to two-dimensional layers, measurements of the compositional and structural uniformity, and of the electrical properties of the islands and layers grown in microgravity. The USML-1 and USML-2 experiments and ground-based studies represent the first investigations of transient crystal growth properties under normal and reduced gravity conditions. The comparative analysis of the ground and USML-2 results showed significant differences. The as-grown surface morphology of the islands and epitaxial layer obtained in microgravity is considerably flatter relative to ground specimens. The compositional microuniformity (IR mapping) and the single crystallinity (etching, X-ray diffraction rocking curves) of the islands and epitaxial layer grown in space are measurably enhanced. These improvements yield carrier mobilities of the materials deposited under microgravity conditions which are greater by a factor of two than those of ground specimens. The significantly improved crystallinity of the space-grown substrate/layer interface relative to that of ground samples shows that any annealing effects during longer growth times (USML-1 experiments) are small. The combined observations of the USML- 1 and USML-2 experiments demonstrate the effects of even small convective flows on the growth processes of this multi-component, multi-reaction, low pressure, solid-vapor transport system. The morphological investigations of the substrate-layer interfaces (heterojunctions) strongly suggest that the formation and propagation of defects is influenced by gravity-related processes during the very initial period of deposition. The combined results show the effects of microgravity on the chemical and structural homogeneity during the transient period. These findings are of general importance for heteroepitaxial growth, independent of the particular growth method employed.
Derived from text

Spaceborne Experiments; Space Processing; Microgravity; Gravitational Effects; Crystal Growth; Crystallinity; Mercury Cadmium Tellurides; Vapor Deposition; Ternary Alloys

19990040362 Massachusetts Inst. of Tech., Dept. of Materials Science and Engineering, CamBridge, MA USA

Identification and Control of Gravity Related Defect Formation During Melt Growth of Bismuth-Silicate (Bi12SiO20)

Zheng, Y., Massachusetts Inst. of Tech., USA; Witt, A. F., Massachusetts Inst. of Tech., USA; NASA Microgravity Materials Science Conference; February 1999, pp. 703-710; In English; See also 19990040241; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

In the light of strong indications that a majority of critical defects formed in bismuth silicon oxide (BSO) during growth from the melt is related directly or indirectly to gravitational interference, it is suggested to use the reduced gravity environment of outer space for experimentation directed at the identification and control of these defects. The results of these experiments are expected to lead to advances in our understanding of crystal growth related defect formation in general and will establish a basis for effective defect engineering, the approach to efficient achievement of defect related, application specific properties in opto-electronic materials
Author

Bismuth Oxides; Melts (Crystal Growth); Crystal Growth; Crystal Defects; Gravitational Effects; Microgravity; Wetting

19990040383 Department of Energy, Office of Energy Research, Washington, DC USA

In-situ x-ray characterization of LiMn2O4: A comparison of structural and electrochemical behavior

Rodriguez, M. A., Department of Energy, USA; Ingersoll, D., Department of Energy, USA; Doughty, D. H., Department of Energy, USA; Feb. 28, 1998; 13p; In English; Sponsored by Materials Research Society, USA

Report No.(s): DE98-003138; SAND-98-0408C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Li(sub x)Mn2O4 materials are of considerable interest in battery research and development. The crystal structure of this material can significantly affect electrochemical performance. The ability to monitor changes of crystal structure during use, that is during electrochemical cycling, would prove useful to verify and control such structural changes. The authors report in-situ XRD measurements of LiMn2O4 cathodes with the use of an electrochemical cell designed for in-situ X-ray analysis. Cells prepared using this cell design allow investigation of the changes in the LiMn2O4 structure during charge and discharge. They describe the variation in lattice parameters along the voltage plateaus and consider the structural changes in terms of the electrochemical results on each cell. Kinetic effects of LiMn2O4 phase changes are also addressed. Applications of the in- situ cell to other compounds such as LiCoO2 cathodes and carbon anodes are presented as well.

NTIS

Manganese Oxides; Lithium Compounds; Crystal Structure; Electrochemistry; X Ray Analysis

19990040589 Department of Energy, Washington, DC USA

Electronic transport mechanism in amorphous tetrahedrally-coordinated carbon films

Sullivan, J. P., Department of Energy, USA; Friedmann, T. A., Department of Energy, USA; Dunn, R. G., Department of Energy, USA; Stechel, E. B., Department of Energy, USA; Schultz, P. A., Department of Energy, USA; Feb. 28, 1998; 8p; In English

Report No.(s): DE98-003136; SAND-97-1673C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The electronic transport mechanism in tetrahedrally coordinated amorphous carbon was investigated using measurements of stress relaxation, thermal evolution of electrical conductivity, and temperature dependent conductivity measurements. Stress relaxation measurements were used to determine the change in 3-fold coordinated carbon concentration, and the electrical conductivity was correlated to this change. It was found that the conductivity was exponentially proportional to the change in 3-fold concentration, indicating a tunneling or hopping transport mechanism. It was also found that the activation energy for transport decreased with increasing anneal temperature. The decrease in activation energy was responsible for the observed increase in electrical conductivity. A model is described wherein the transport in this material is described by thermally activated conduction along 3-fold linkages or chains with variable range and variable orientation hopping. Thermal annealing leads to chain ripening and a reduction in the activation energy for transport.

NTIS

Energy Transfer; Amorphous Materials; Carbon

19990040671 Oak Ridge National Lab., Solid State Div., TN USA

Collective excitations in a 2D electron system: Canted field geometry

Marinescu, D. C., Oak Ridge National Lab., USA; Quinn, J. J., Oak Ridge National Lab., USA; Wojs, A., Oak Ridge National Lab., USA; Jun. 30, 1998; 7p; In English; 13th; SemiMag; Sponsored by Department of Energy, USA

Report No.(s): DE99-000359; ORNL/CP-98839; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The authors investigate the charge and spin collective modes induced in a 2D electron gas by a weak electromagnetic perturbation in the presence of a dc magnetic field which makes an angle (theta) with the electron layer. The excitation frequencies are determined within the framework of the Landau-Silin theory of Fermi liquids by solving a semi-classical equation for transport in the self-consistent electromagnetic field associated with particle density fluctuations. The quasiparticle interaction is spin dependent and varies parametrically with the degree of spin polarization. In the long wavelength limit, they obtain analytic results for the frequencies of the collective modes as functions of (theta).

NTIS

Electric Fields; Elementary Excitations; Electron Gas; Particle Spin

19990040697 Los Alamos National Lab., NM USA

Pu 4f XPS spectra analyzed in the Anderson impurity model

Cox, L. E.; Peek, J. M.; Allen, J. W.; May 09, 1998; 9p; In English; Strongly correlated electron systems

Report No.(s): DE99-000749; LA-UR-98-2152; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

X-ray photoemission spectra of the (alpha),(beta),(gamma), and (delta) phases of Pu have been analyzed using the Gunnarsson-Schonhammer implementation of the Anderson impurity model. Changes in the relative intensities of the two spectral features representing mixed f(exp 5) and f(exp 6) final states are in reasonable agreement with the model's predictions. The coulomb terms, U(sub ff) calculations. Multiplet structure, which agrees with atomic calculations for 4f(sup 13)5f(sup 5), strongly suggests 5f localization in the final state.

NTIS

Impurities; X Ray Spectra; Plutonium

19990040775 Los Alamos National Lab., NM USA

Structure of fillers, polymers and their interfaces in polymer composites using neutron scattering methods

Hjelm, R. P.; Dec. 31, 1998; 10p; In English; 153rd; Technical meeting of the American Chemical Society Rubber Division

Report No.(s): DE99-001135; LA-UR-98-2357; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The neutron scattering methods, small-angle neutron scattering and neutron reflectometry, provide information on the structure of polymer composite materials that is not available from other structural probes. The unique capabilities of these methods derive from three factors. First, the length scales probed correspond to polymer conformation, molecular and domain scales and to the characteristic sizes of many fillers. Second, neutrons are able to penetrate relatively thick samples, allowing bulk samples to be measured, and enabling buried interfaces to be studied. This characteristic also allows for the construction of special sample containment needed for studying materials under stress, extremes in pressure and temperature, etc. Third, neutrons readily distinguish between different light elements, and between different isotopes of the same element. The ability to distinguish between hydrogen and deuterium is particularly important in this regard. New ways of exploiting the capabilities of neutrons are opening up with the development of improved sources and instruments in the US and elsewhere. In this talk the author will discuss the basic concepts that give rise to the unique capabilities of neutron scattering, giving several examples of the uses of neutron scattering techniques in the study of polymer composites. The examples will include the morphology of fillers, polymer binders and matrices, interfaces and defect structures.

NTIS

Fillers; Polymer Matrix Composites; Penetration; Optical Measurement; Containment; Binders (Materials)

19990040791 Los Alamos National Lab., NM USA

Photoemission in strongly correlated crystalline f-electron systems: A need for a new approach

Arko, A. J.; Joyce, J. J.; Sarrao, J.; Dec. 31, 1998; 75p; In English; Electron Correlations and Materials Properties

Report No.(s): DE99-001131; LA-UR-98-2390; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The unusual properties of heavy fermion (or heavy electron) materials have sparked an avalanche of research over the last two decades in order to understand the basic phenomena responsible for these properties. Photoelectron spectroscopy (often referred to as PES in the following sections), the most direct measurement of the electronic structure of a material, should in principle be able to shed considerable light on this matter. In general the distinction between a localized and a band-like state is trivially observed in band dispersion. Much of the past work was performed on poly-crystalline samples, scraped in-situ to expose a clean surface for PES. There have since been considerable advances both in the quality of specimens as well as experimental resolution, which raise questions regarding these conclusions. Much of the past work on poly-crystalline samples has been reported in several review articles, most notably Allen et al., and it is not necessary here to review those efforts again, with the exception of subsequent work performed at high resolution. The primary focus of the present review will be on new measurements obtained on single crystals, cleaved or prepared in situ and measured at high resolution, which seem to suggest that agreement with the GS and NCA approximations is less than perfect, and that perhaps the starting models need to be modified, or that even an entirely new approach is called for. of the promising new models the Periodic Anderson Model is most closely related to the SIM. Indeed, at high temperatures it reverts to the SIM. However, the charge polaron model of Liu (1997) as well as the two-electron band model of Sheng and Cooper (1995) cannot yet be ruled out. Inasmuch as the bulk of the single crystal work was performed by the Los Alamos group, this review will draw heavily on those results. Moreover, since the GS and NCA approximations represent the most comprehensive and widely accepted treatment of heavy fermion PES, it is only natural that the authors primarily concern themselves with analysis of PES data in terms of these models, in order to thoroughly test their validity in light of the new data.

NTIS

Photoelectron Spectroscopy; Electronic Structure; Photoelectric Emission; Fermions; Crystallinity; Avalanches

19990040794 Los Alamos National Lab., NM USA

Many body theory program

Balatsky, A. V.; Scalapino, D.; Wilkins, J.; Pines, D.; Bedell, K.; Dec. 31, 1998; 11p; In English

Report No.(s): DE99-001122; LA-UR-98-1708; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The authors have obtained a description of symmetry of the order parameter and pairing state in high-Tc superconductors. They developed a theory of ferromagnetic instability of Fermi-liquid. They have conducted an experimental investigation of the intermetallic compounds and Zintl-type compound. They investigated the properties of Cu-O ladders. They have developed the theory of Lifshitz tails in superconductors.

NTIS

Symmetry; Superconductors (Materials); High Temperature Superconductors; Experimentation; Ferromagnetic Materials

19990040798 Los Alamos National Lab., Materials Science and Technology Div., NM USA

Mo5Si3 single crystals: Physical properties and mechanical behavior

Chu, F.; Thoma, D. J.; McClellan, K. J.; Peralta, P.; Dec. 31, 1998; 25p; In English; High temperature structural silicide

Report No.(s): DE99-001079; LA-UR-98-2267; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The materials processing, physical properties and mechanical behavior of an ultra-high temperature structural silicide, Mo5Si3, have been studied. High purity single crystals of Mo5Si3 have been synthesized by both optical floating zone and Czochralski methods. The thermal and elastic properties of the Mo5Si3 single crystals were experimentally measured. Results show that Mo5Si3 has significant thermal expansion anisotropy along the a and c directions with alpha(sub c)/alpha(sub a) = 2.2. Single crystal elastic moduli of Mo5Si3 indicate that it has less elastic anisotropy and lower shear moduli than transition metal disilicides. Tensile stresses of up to 1.8 GPa can develop at grain boundaries after cooling from the melting point due to the thermal expansion mismatch in Mo5Si3, causing grain boundary cracking during processing of polycrystals. Room temperature Vickers indentation tests on (100) and (001) planes have been performed with different indenter diagonal orientations. The orientation dependence of hardness and fracture toughness of Mo5Si3 single crystals have been obtained. The corresponding deformation and fracture modes have been revealed by microscopy studies. A comparison of Mo5Si3 with other high temperature structural silicides, e.g., C11(sub b) and C40 transition metal disilicides, is discussed.

NTIS

Single Crystals; Molybdenum Compounds; Silicon Compounds; Elastic Properties; Thermodynamic Properties

19990040810 Department of Energy, Office of Energy Research, Washington, DC USA

Relationship between grain-boundary migration and grain-boundary diffusion by molecular-dynamics simulation

Schoenfelder, B., Department of Energy, USA; Keblinski, P., Department of Energy, USA; Wolf, D., Department of Energy, USA; Phillpot, S. R., Department of Energy, USA; Jul. 31, 1998; 9p; In English; 9th; Integranular and Interphase Boundaries in Materials, USA

Report No.(s): DE98-058042; ANL/MSD/CP-96991; CONF-980744; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

A molecular-dynamics method for the simulation of the intrinsic migration behavior of individual, flat grain boundaries is presented. A constant driving force for grain-boundary migration is generated by imposing an anisotropic elastic strain on a bicrystal such that the elastic-energy densities in its two halves are different. For the model case of the large-planar-unit-cell, high-angle (001) twist boundary in Cu, the authors demonstrate that the drift velocity is proportional to the applied driving force, thus enabling determination of the boundary mobility. The activation energy for grain- boundary migration is found to be distinctly lower than that for grain-boundary self-diffusion. A decrease in the related activation energies with increasing temperature is shown to arise from a crossover in the underlying mechanisms, from solid-like at low temperatures to liquid-like at high-temperatures that is accompanied by an underlying grain-boundary structural transition.

NTIS

Grain Boundaries; Diffusion; Drift Rate; Flux Density; Migration; Mobility; Molecular Dynamics

19990040814 Department of Energy, Washington, DC USA

Imaging crystal/spectral line search

Koch, J. A., Department of Energy, USA; Feb. 16, 1998; 148p; In English

Report No.(s): DE98-057747; UCRL-ID-129951; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The table is a compilation of chance coincidences between x-ray line wavelengths and crystal planes which reflect those wavelengths near normal incidence. The motivation is to explore the possibilities for expanding the range of choices for near normal incidence x-ray crystal imaging.

NTIS

Crystals; X Ray Imagery; Line Spectra; Imaging Techniques; Crystal Structure; X Ray Irradiation

19990040828 Lawrence Livermore National Lab., Livermore, CA USA

Applications and advances of positron beam spectroscopy, Appendix a

Howell, R.; Nov. 05, 1997; 415p; In English, 5-7 Nov. 1997, Livermore, Ca, USA

Report No.(s): DE98-058816; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Over 50 scientists from DOE-DP, DOE-ER, the national laboratories, academia and industry attended a workshop held on November 5-7, 1997 at Lawrence Livermore National Laboratory. Workshop participants were charged to address two questions: Is there a need for a national center for materials analysis using positron techniques and can the capabilities at Lawrence Livermore National Laboratory serve this need. to demonstrate the need for a national center, the workshop participants discussed the techni-

cal advantages enabled by high positron currents and advanced measurement techniques, the role that these techniques will play in materials analysis and the demand for the data. There were general discussions lead by review talks on positron analysis techniques, and their applications to problems in semiconductors, polymers and composites, metals and engineering materials, surface analysis and advanced techniques. These were followed by focus sessions on positron analysis opportunities in these same areas. There was a detailed discussion of the LLNL capabilities and a tour of the facilities. This document is a supplement to the written summary report (DE98058793). It contains a complete schedule, list of attendees and the vuegraphs for the presentations in the review and focus sessions.
NTIS
Positrons; Electron Spectroscopy

19990040829 Lawrence Livermore National Lab., Livermore, CA USA
Applications and advances of positron beam spectroscopy
Howell, R.; Mar. 18, 1998; 19p; In English, 5-7 Nov. 1997, Livermore, CA, USA
Report No.(s): DE98-058793; UCRL-JC-130205; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
Over 50 scientists from DOE-DP, DOE-ER, the national laboratories, academia and industry attended a workshop held on November 5-7, 1997 at Lawrence Livermore National Laboratory. Workshop participants were charged to address two questions: Is there a need for a national center for materials analysis using positron techniques and can the capabilities at Lawrence Livermore National Laboratory serve this need. to demonstrate the need for a national center, the workshop participants discussed the technical advantages enabled by high positron currents and advanced measurement techniques, the role that these techniques would play in materials analysis and the demand for the data. Livermore now leads the world in materials analysis capabilities by positrons due to developments in response to demands of stockpile stewardship. The Livermore facilities now include the world's highest current beam of keV positrons, a scanning pulsed positron microprobe under development capable of three dimensional maps of defect size and concentration, an MeV positron beam for defect analysis of large samples, and electron momentum spectroscopy by positrons. It was concluded that the positron microprobe under development at LLNL and other new instruments that would be relocated at LLNL at the high current keV source are an exciting step forward in providing results for the positron technique. These new data will impact a wide variety of applications.
NTIS
Electron Spectroscopy; Positrons

19990040830 Lawrence Livermore National Lab., Livermore, CA USA
CAVE: the design of a precision metrology instrument for studying performance of KDP crystals
Hibbard, R. L.; Mar. 30, 1998; 6p; In English; Diffractive optic and micro optics, 1998
Report No.(s): DE98-058767; UCRL-JC-130318; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
A device has been developed to measure the frequency conversion performance of large aperture potassium dihydrogen phosphate (KDP) crystals. Third harmonic generation using ICDP is critical to the function of the National Ignition Facility (NIF) laser. The crystals in the converter can be angularly or thermally tuned but are subject to larger aperture inhomogeneities that are functions of growth manufacturing and - mounting. The CAVE (Crystal Alignment Verification Equipment) instrument scans the crystals in a thermally and mechanically controlled environment to determine the local peak tuning angles. The CAVE can then estimate the optimum tuning angle and conversion efficiency over the entire aperture. Coupled with other metrology techniques, the CAVE will help determine which crystal life-cycle components most affect harmonic conversion.
NTIS
Metrology; Crystals; Potassium Phosphates; Alignment; Proving

19990040876 General Atomics Co., San Diego, CA USA
International summer school on macromolecular crystallographic computing ***Final Report***
Aug. 31, 1998; 4p; In English; 17th; Congress and general assembly of the international union of crystallography (IUCr), USA
Report No.(s): DE99-000094; GA-A22949; No Copyright; Avail: Department of Energy Information Bridge, Microfiche
The School was the seventh in a series of International Union of Crystallography (IUCr) Crystallographic Symposia. The format of the School was formal lectures in the morning, tutorials in the afternoon, and software demonstrations and more lectures in the evening. The full program which left both the organizers and attendees exhausted, reflects the current state of excitement in the field of macromolecular structure determination using the technique of X-ray crystallography. The new and improved technologies and techniques described in these Proceedings are contributing to that growth and at the same time, as pointed out in the paper given by Sussman, creating challenges for the Protein Data Bank (PDB). As the School progressed, the authors were struck by the similarities to events which took place in small molecule crystallography beginning some 20 to 25 years ago. Growth

then was fueled by the advent of new algorithms, affordable computer hardware, and good software. So it is today for macromolecular crystallography, but with the added bonus of the Internet which is changing how scientist conduct their research. Flack presented this view as part of his on-going contribution to how crystallographers use the Internet. After presentations discussing structures en masse they returned to the more traditional mode of presentation which parallels the determination of a single macromolecular structure: data collection -- phasing -- model building and visualization -- refinement.
NTIS
Conferences; Crystallography; Macromolecules

19990040958 Department of Energy, Washington, DC USA
Electron emission following the interaction of slow highly charged ions with solids
McDonald, J. W.; Jan. 01, 1998; 93p; In English
Report No.(s): DE98-058705; UCRL-ID-129535; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The interaction of highly-charged ions with surfaces involves many excitation processes of the surface atoms and the bulk material. One such process, the emission of electrons from surfaces due to the potential energy of the incident ions has been studied. The experimental results presented here confirm that the majority of electrons emitted as a result of highly-charged ions interacting with a solid surface have energies of about 20 eV. Auger processes contribute a smaller fraction of the total emitted electrons with increasing Z of the projectile. This contribution to the total electron emission yield is found to be less than 5% for Ne(sup 9+) and less than 1% for Ar(sup 18+). For Z(>=) 54, no Auger electrons were detected. The early indications that the total number of emitted low energy electrons increases linearly with charge have been demonstrated not to hold for q (>=) 18.
NTIS
Electron Emission; Solids; Ions; Ion Atom Interactions

19990041055 NASA Lewis Research Center, Cleveland, OH USA
Fine Structure in the Secondary Electron Emission Peak for Diamond Crystal with (100) Negative Electron Affinity Surface
Asnin, V. M., NASA Lewis Research Center, USA; Krainsky, I. L., NASA Lewis Research Center, USA; Applied Physics Letters; Dec. 21, 1998; ISSN 0003-6951; Volume 73, No. 25, pp. 3727-3729; In English; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

A fine structure was discovered in the low-energy peak of the secondary electron emission spectra of the diamond surface with negative electron affinity. We studied this structure for the (100) surface of the natural type-IIb diamond crystal. We have found that the low-energy peak consists of a total of four maxima. The relative energy positions of three of them could be related to the electron energy minima near the bottom of the conduction band. The fourth peak, having the lowest energy, was attributed to the breakup of the bulk exciton at the surface during the process of secondary electron emission.
Author
Electron Emission; Diamonds; Crystals; Secondary Emission; Fine Structure

19990041076 Oak Ridge National Lab., TN USA
Modeling of nucleation during recrystallization
Radhakrishnan, B.; Sarma, G.; Zacharia, T.; Dec. 31, 1998; 10p; In English; 3rd; International conference on grain growth
Report No.(s): DE99-000364; ORNL/CP-98633; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The number density and spatial distribution of nuclei determine the kinetics, and the evolution of microstructure and texture during recrystallization. The potential nucleation sites are the high angle boundaries that exist in the deformed microstructure. These could be either the original grain boundaries prior to deformation or boundaries created due to non-uniform plastic deformation on the microscopic scale. Discontinuous subgrain growth with or without the formation of high angle boundaries may also occur during recrystallization in the presence of long range orientation gradients existing in the deformation substructure. The paper presents Monte Carlo simulation results on the evolution of substructures for each of the above nucleation mechanisms.

The evolution of recrystallized grain structure from a realistic substructure obtained by modeling the deformation of fcc polycrystals at the microstructural level is presented, and shows the collective contribution of the above nucleation mechanisms during recrystallization and grain growth. The simulations capture not only the kinetics and microstructural evolution but also the evolution of texture during recrystallization.
NTIS
Recrystallization; Simulation; Models; Spatial Distribution; Density Distribution; Crystal Growth; Microstructure

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THERMODYNAMICS AND STATISTICAL PHYSICS

Includes quantum mechanics; theoretical physics; and Bose and Fermi statistics. For related information see also 25 Inorganic and Physical Chemistry and 34 Fluid Mechanics and Heat Transfer.

19990040324 Polytechnic Univ., Dept. of Chemical Engineering, Brooklyn, NY USA
Thermodynamic and Statistical Studies of Supersaturated Ternary Solutions
Izmailov, Alexander F., Polytechnic Univ., USA; Myerson, Allan S., Polytechnic Univ., USA; NASA Microgravity Materials Science Conference; February 1999, pp. 487-492; In English; See also 19990040241; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

It is well known that small amounts of impurity can profoundly effect nucleation and crystal growth. For example, it has been reported that Pb(+2) acts as a nucleation agent in a NaCl solution, whereas Co(+2) inhibits nucleation in KNO3 solution. The effect of K(+) and Fe(+3) ions on nucleation of ammonium-aluminum sulfates was studied in. The study of Cr(+3) impurities in different supersaturated solutions has demonstrated that in their presence nucleation and crystal growth are suppressed. All these studies have been performed in bulk solutions and, therefore, have only qualitative reproducibility. In addition, no mechanistic understanding of these effects can be obtained from the normal bulk experiments. Particularly it is not possible to distinguish whether the impurity effects thermodynamics of the system in some way or alters kinetics of the nucleation and growth processes. In order to obtain reproducible quantitative results related to the effect of an impurity on nucleation, an accurate and sensitive experimental technique is required which allows preparation of stable supersaturated solutions. to the best of our knowledge the only experimental technique capable of achieving these results is based on containerless levitation of solution microdroplets in a solvent atmosphere. Preliminary results of the study of the impact of an impurity (Cr(+3) ions) on nucleation of ammonium sulfate ((NH4)2SO4) in aqueous solution by studying the dependence of water activity on ((NH4)2SO4) concentration have been reported. In this paper we present results of experimental and theoretical study of the impact of small amounts of ionic impurities such as Cr(+3) on nucleation of ((NH4)2SO4) in aqueous supersaturated solution.
Derived from text
Crystal Growth; Nucleation; Thermodynamics; Ions; Impurities; Aqueous Solutions; Statistical Analysis; Supersaturation; Ternary Alloys

19990040653 Sandia National Labs., Albuquerque, NM USA
Magnetic breakdown and Landau level spectra of a tunable double-quantum-well Fermi surface
Simmons, J. A.; Harff, N. E.; Lyo, S. K.; Klem, J. F.; Boebinger, G. S.; Dec. 31, 1997; 5p; In English; 12th; EP2DS-12: Electronic properties of two-dimensional systems
Report No.(s): DE99-000402; DOE/AL/85000-T4; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

By measuring longitudinal resistance, the authors map the Landau level spectra of double quantum wells as a function of both parallel (B(sub (parallel))) and perpendicular (B(sub (perpendicular))) magnetic fields. In this continuously tunable highly nonparabolic system, the cyclotron masses of the two Fermi surface orbits change in opposite directions with B(sub (parallel)). This causes the two corresponding ladders of Landau levels formed at finite B(sub (perpendicular)) to exhibit multiple crossings. They also observe a third set of landau levels, independent of B(sub (parallel)), which arise from magnetic breakdown of the Fermi surface. Both semiclassical and full quantum mechanical calculations show good agreement with the data.
NTIS
Magnetic Fields; Quantum Wells; Fermi Surfaces; Spectra

80
SOCIAL SCIENCES (GENERAL)

Includes educational matters.

19990041016 Bionetics Corp., Cocoa Beach, FL USA
Continuing Education
Hoffler, G. Wyckliffe, Bionetics Corp., USA; Proceedings from the 1998 Occupational Health Conference: Benchmarking for Excellence; February 1999, pp. 204; In English; See also 19990040967; No Copyright; Avail: CASI; A01, Hardcopy; A03, Microfiche

Earning continuing education credits can be a welcome byproduct of conferences. Many disciplines that are essential to support NASA operations, require maintaining and updating knowledge of personnel for licensure and certification. These requirements can be satisfied through various forms of continuing education. Official credits that satisfy requirements for professional licensure or certification must be authorized by a recognized organization. This usually implies academic liaisons and acknowledged expertise which are not generally available within NASA. For personnel attending the Occupational Health Conference, we sought third-party accreditation for four professional disciplines. Physicians received credit through the Aerospace Medical Association, nurses through the American Association of Occupational Health Nurses, Inc., industrial hygienists through the American Board of Industrial Hygiene, and exercise specialists through the American College of Sports Medicine. In each case, specific requirements were furnished to meet standards of the accrediting organization. These requirements assure that the instruction meets acceptable standards, that claimants' evaluations are returned, and that attendance is verified. Appropriate documentation was submitted to allow granting of continuing education credits. It is noteworthy that this was the first such offering by NASA for attending occupational health nurses.
Derived from text
Education; Aerospace Medicine; Certification

81
ADMINISTRATION AND MANAGEMENT

Includes management planning and research.

19990040643 Defense Contract Audit Agency, Washington, DC USA
DCAA Contract Audit Manual. Vol. 1 of 2, Chapters 1-8
Jan. 1999; 854p; In English
Report No.(s): PB99-129314; No Copyright; Avail: CASI; A99, Hardcopy; A10, Microfiche

Contents include the following: Introduction to Contract Audit; Auditing Standards; Audit Planning; General Audit Requirements; Review of Policies, Procedures, and Internal Controls Relative to Accounting and Management Systems.
NTIS
Contracts; Accounting; Management Systems

19990040688 Office of Science and Technology, Washington, DC USA
National Science and Technology Council Annual Report, 1998
Feb. 1999; 50p
Report No.(s): PB99-132862; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The President established the National Science and Technology council (NSTC) in 1993 to ensure that the Nation's investment in science and technology (S&T) is coordinated among the diverse parts of the Federal research and development enterprise. During 1998 the NSTC has worked closely with the Office of Management and Budget (OMB) to develop research and development (R&D) budget guidance for the Federal departments and agencies so that our S&T investments are integrated into the overall national agenda. An important objective of the NSTC is to guide the individual agency budget priorities for R&D and to orient the S&T spending of each Federal mission agency toward achieving national goals. To meet this objective, the NSTC has established five goal-oriented committees each which is chaired jointly by a senior agency official and an Office of Science and Technology Policy Associate Director. These standing committees, along with ad hoc working groups within the NSTC, provide an effective forum to resolve cross-cutting issues.
NTIS
Research and Development; Science; Governments

19990040771 NASA Langley Research Center, Hampton, VA USA

Tools and Techniques for Decomposing and Managing Complex Design Projects

Rogers, James L., NASA Langley Research Center, USA; Journal of Aircraft; January-February 1999; Volume 36, No. 1, pp. 266-274; In English; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

Many companies are looking for new tools and techniques to aid a design manager in making decisions that can reduce the time and cost of a design cycle. One tool that is available to aid in this decision- making process is the design manager's aid for intelligent decomposition (DeMAID). Since the initial public release of DeMAID in 1989, much research has been done in the areas of decomposition, concurrent engineering, and process management, and many new tools and techniques have been developed. Based on this research and development, numerous enhancements have been added to DEMAID to aid the design manager in saving both cost and time in a design cycle. The key enhancement, a genetic algorithm (GA), is available in the most recent public release called DeMAID/GA. The GA orders the sequence of design processes to minimize the cost and time to converge to a solution. Several of the most recent advances are discussed and compared with the enhancements in DeMAID/GA. An example of an aircraft conceptual design project is used to show how these enhancements can be applied to improve the design cycle. Author

Research and Development; Engineering Management; Procedures; Computer Aided Design; Concurrent Engineering

19990040995 NASA Stennis Space Center, Bay Saint Louis, MS USA

Self-Disclosure as a Predictor of EAP Supervisory Utilization

Donohoe, Timothy L., NASA Stennis Space Center, USA; Johnson, James T., University of Southern Mississippi, USA; Taquino, Maurice A., NASA Stennis Space Center, USA; Proceedings from the 1998 Occupational Health Conference: Benchmarking for Excellence; February 1999, pp. 136-138; In English; See also 19990040967; No Copyright; Avail: CASI; A01, Hardcopy; A03, Microfiche

The value of Employee Assistance Programs (EAPS) has been cited in a variety of published papers and articles. An important managerial element relative to the assessment and referral of troubled employees has been supervisory training. There has been numerous studies highlighting the various factors and circumstances associated with supervisory behavior and EAP referrals. The inclusion of emotional awareness factors in EAP supervisory utilization has not been thoroughly investigated, although frequently found in the literature as a training and development objective for managers in business and education. The present study sought to determine what role supervisory denial and anxiety avoidance plays in confrontation of troubled employees and if admission of specific, internal emotional events is a characteristic among EAP utilizing supervisors.

Derived from text

Emotional Factors; Personnel Management

19990040998 Kelsey Seybold Clinic, P.A., Houston, TX USA

ISO Excellence at JSC

Goldberg, Sheila, Kelsey Seybold Clinic, P.A., USA; Siemens, Rebecca, Kelsey Seybold Clinic, P.A., USA; Proceedings from the 1998 Occupational Health Conference: Benchmarking for Excellence; February 1999, pp. 148-152; In English; See also 19990040967; No Copyright; Avail: CASI; A01, Hardcopy; A03, Microfiche

The International Organization for Standardization (ISO) is a worldwide federation of over 100 nations that create international standards. The ISO 9000 series is designed to standardize performance quality in global arenas. When NASA Director, Daniel S. Goldin, announced in July 1996, "NASA will be in the forefront of ISO 9000 implementation within the government," Johnson Space Center (JSC) geared up for ISO certification. Foreseeing future contract requirements, the management of the JSC Occupational Medicine and Environmental Health contractor, Kelsey-Seybold Clinic, P.A., decided to also seek ISO 9000 registration of all contract departments. Goals were set by JSC and Kelsey-Seybold to be ISO certified by the end of 1997.

Derived from text

Contract Management; Certification; Standardization; Quality Control

19990041004 Edgerton, Germeshausen and Grier, Inc., Cocoa Beach, FL USA

The Employee Assistance Program and the Workplace Violence Working Group: "Benchmarking in Tierra Incognita"

McGuire, Wiliam T., Edgerton, Germeshausen and Grier, Inc., USA; Proceedings from the 1998 Occupational Health Conference: Benchmarking for Excellence; February 1999, pp. 165; In English; See also 19990040967; No Copyright; Avail: CASI; A01, Hardcopy; A03, Microfiche; Abstract Only; Abstract Only

In early 1995 KSC was tasked with developing a Crisis Management Plan to address the emerging issue of workplace violence. Shortly thereafter, the bombing of the Alfred P. Murrah Government Building in Oklahoma City underscored the importance of this task. This task was designed to be a collaborative effort involving a number of directorates and Employee Assistance

Program (EAP) personnel. This event marked the first time that the EAP Program had been formally integrated into organizational planning and decision making. The team is called the Workplace Violence Working Group and has as its goal, the development of policy, procedures for reporting threats of violence, a training and information program and a threat assessment team. The benchmarking process used (planning, analysis, integration, action and maturity) is explained and how the role of the EAP on the team is defined. This task remains a ”work in progress.” Proposed policy and procedures have been developed. The assessment team has functioned effectively in several incidents. Various training events and new technologies have been presented and evaluated by the team. The EAP has been an integral part of the process and developed a procedure for ”psychological triage” as part of the crisis management plan. The collaborative approach allowed the team to benefit from a variety of perspectives and expertise. It has greatly enhanced our understanding of what each member can contribute to the team. It was also beneficial to collaborate with other centers, agencies and companies in seeking best practices and to avoid operating in isolation.
Derived from text
Management Planning; Violence; Emergencies; Safety Management

19990041007 Kelsey Seybold, Houston, TX USA
Rebuilding the JSC Employee Assistance Program
Reese, Jacqueline E., Kelsey Seybold, USA; Proceedings from the 1998 Occupational Health Conference: Benchmarking for Excellence; February 1999, pp. 178-179; In English; See also 19990040967; No Copyright; Avail: CASI; A01, Hardcopy; A03, Microfiche

Three primary tasks were essential in rebuilding the Johnson Space Center (JSC) Employee Assistance Program (EAP). The program was staffed with licensed, clinically trained psychotherapists and experienced support personnel. The program was designed to comply with national EAPA standards and the standard of care of the American Counseling Association (ACA). In December 1997, the JSC EAP obtained ISO 9000 certification. Current services of assessment, brief therapy, referral, and seminar presentations were expanded to include on-site emergency interventions and debriefing, and assistance to the ERT. They also include coordination with the EOC, participation in a formal disaster plan, case management, coordination of services with Human Resources (HR) and Equal Employment Opportunity (EEO), and expanded specialized resource referrals. Staff visibility was increased through brief introductory outreaches. Posters, brochures, newspaper articles a web-site, and a booth at Safety and Total Health Day were utilized. Program utilization has tripled in the past year.
Derived from text
Medical Services; Human Resources; Health

19990041008 Kelsey Seybold, Houston, TX USA
Johnson Space Center Safety and Total Health Day
Reinoso, Janelle, Kelsey Seybold, USA; Goldberg, Sheilla, Kelsey Seybold, USA; Proceedings from the 1998 Occupational Health Conference: Benchmarking for Excellence; February 1999, pp. 180-181; In English; See also 19990040967; No Copyright; Avail: CASI; A01, Hardcopy; A03, Microfiche; Abstract Only; Abstract Only

Safety and good health are a person’s most vital assets in living a full and productive life. Recognizing this, JSC has set aside one day each year devoted entirely to safety and health education. The Safety and Total Health (S&TH) Day Steering Committee primarily coordinates this day. Membership is made up of chairs of the following subcommittees, and usually begins to meet about six months before S&TH Day. The Logistics Subcommittee coordinates booth and seminar locations and prepares a map of activities that is distributed to employees. The Booth Recruitment Subcommittee obtains booth participants from on-site and off-site contractors, community services, and private companies. They are responsible for communication with these groups concerning S&TH Day logistics and rules. The Advertising Subcommittee communicates the events of S&TH Day to all on-site and off-site civil service and contractor employees by distributing catalogues and maps of all booths and seminars prior to the event. This advance notice allows employees and managers the opportunity to schedule their day to derive the maximum benefit from the day’s activities. The Managers’ Support Subcommittee handles the coordination of the T-2 month Managers Meeting. This informational meeting, held two months before S&TH Day, communicates to civil service and contractor managers the resources available for planning in-house S&TH Day activities. Central to S&HT Day is the program designed by individual management teams specifically for their employees’ needs and interests. Booths, located around the central JSC mall, are open on S&TH Day from 10:00 to 15:00. In addition to booths and seminar speakers, several special events are held in conjunction to S&TH Day. They include: the Children’s Safety and Health Calendar Contest; Fun Run/Walk; a Blood Drive; mass Cardiopulmonary Resuscitation (CPR) training sessions in the morning and afternoon; safety and health videos broadcast over the on-site television channel throughout the day; and an outdoor lunch concert by a JSC-based band. Johnson Space Center has found that having an annual day dedicated to health and safety awareness has many advantages: (1) We can save lives; we can change lives; (2) People are the ultimate source of safety and health. S&TH Day is an opportunity for the JSC community to increase their awareness of safety

and total health. A healthy work force is our strongest asset; (3) Employee and line management involvement in safety and health will increase. to plan a successful S&TH Day, start early and involve as many people as practical. "Your employees will get as much out of this day as you put into preparing for it."
Derived from text
Health; Public Relations; Education

19990041011 NASA Kennedy Space Center, Cocoa Beach, FL USA
Profile of Ambulance Runs at the Kennedy Space Center
Scarpa, Philip J., NASA Kennedy Space Center, USA; Proceedings from the 1998 Occupational Health Conference: Benchmarking for Excellence; February 1999, pp. 188-190; In English; See also 19990040967; No Copyright; Avail: CASI; A01, Hardcopy; A03, Microfiche

The Kennedy Space Center (KSC) has four onsite ambulances staffed with Paramedics at two fire stations that respond to 911 Emergency Medical System (EMS) medical dispatches. These ambulances serve over 22,000 NASA, military, government, and contractor employees in an area of approximately 520 square miles. Included in this coverage are several public areas such as beaches, a wildlife refuge and a popular Visitor Center. Reports are filled out on each patient encountered. However. the only element tracked has been the ambulance response time. Now that reports are filed electronically, it is possible to enter them into an electronic database for analysis. Data analyses reveal trends and assist in better allocation of resources.
Derived from text
Ambulances; Emergencies; Medical Services; Health

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DOCUMENTATION AND INFORMATION SCIENCE

Includes information management; information storage and retrieval technology; technical writing; graphic arts; and micrography. For computer documentation see 61 Computer Programming and Software.

19990039573 Department of Energy, Washington, DC USA
Nuclear data libraries for incident neutrons and protons to 150 MeV in ENDF- 6 format
Chadwick, M. B., Department of Energy, USA; Frankle, S. C., Department of Energy, USA; Little, R. C., Department of Energy, USA; Young, P. G., Department of Energy, USA; Feb. 28, 1998; 10p; In English; Sponsored by American Nuclear Society, USA
Report No.(s): DE98-002929; LA-UR-97-4772; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

As part of the Accelerator Production of Tritium (APT) program, an effort is underway at Los Alamos National Laboratory to develop nuclear data libraries for incident neutrons and protons to 150 MeV. The libraries will be used in the MCNP Monte Carlo code with appropriate linking to higher energy calculations with the LAHET intranuclear cascade code. The data code system will be used for design of an accelerator-based facility to produce tritium, and will provide information required for analysis of system performance, induced radiation doses, material activation, heating, damage, and shielding analysis. Because of their completeness, the libraries will also be useful for other accelerator- driven applications and for medical, shielding, and space applications at higher energies. The libraries are based primarily on nuclear model calculations with the GNASH reaction theory code, including thorough benchmarking of the model calculations against experimental data. All evaluations are in ENDF-6 format and include specification of production cross sections for light particles, gamma rays, and heavy recoil particles, energy angle correlated spectra for secondary light particles, and energy spectra for gamma rays and heavy recoil nuclei. The neutron evaluations are combined with ENDF/B-VI evaluations below 20 MeV. To date, neutron and proton evaluations have been completed for (sup 2)H, (sup 12)C, (sup 14)N, (sup 16)O, (sup 27)Al, (sup 28,29,30)Si, (sup 40)Ca, (sup 50,52,53,54)Cr, (sup 54,56,57,58)Fe, (sup 58, 60,61,62,64)Ni, (sup 182,183,184,186)W, and (sup 206,207,208)Pb.
NTIS
Data Systems; Nuclear Models; Libraries; Protons; Neutrons; Linear Accelerators; Data Acquisition

19990040591 Department of Energy, Office of Environmental Restoration and Waste Management, Washington, DC USA
Designing a Database for Performance Assessment: Lessons Learned from WIPP
Martell, M. A., Department of Energy, USA; Schenker, A., Department of Energy, USA; Dec. 31, 1997; 6p; In English; High-Level Radioactie Waste Management, 1998, USA
Report No.(s): DE98-001679; SAND-97-2777C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The Waste Isolation Pilot Plant (WIPP) Compliance Certification Application (CCA) Performance Assessment (PA) used a relational database that was originally designed only to supply the input parameters required for implementation of the PA codes.

Reviewers used the database as a point of entry to audit quality assurance measures for control, traceability, and retrievability of input information used for analysis, and output/work products. During these audits it became apparent that modifications to the architecture and scope of the database would benefit the EPA regulator and other stakeholders when reviewing the recertification application. This paper contains a discussion of the WIPP PA CCA database and lessons learned for designing a database.
NTIS
Radioactive Wastes; Waste Disposal; Information Systems; Quality Control

19990040832 Geological Survey, Biological Resources Div., Reston, VA USA
Geospatial Technology Applications and Infrastructure in the Biological Resources Division
Sep. 1998; 62p; In English
Report No.(s): AD-A361200; USGS/BRD/ITR-1998-0001; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

This report addresses the use and applications of geospatial technology in the Biological Resources Division (BRD) of the U.S. Geological Survey. Information on geospatial technology activities and resources at BRD centers and programs is linked to the BRD Geospatial Technology Strategic Plan. Activities listed represent only a sampling of ongoing geospatial applications and infrastructure; new projects are implemented on a regular basis. The use and application of geospatial technology is rapidly expanding Division-wide, as demonstrated by the breadth of applications discussed. This document provides an inventory of geospatial capabilities that currently exist within the centers, field stations, and programs of the BRD.
DTIC
Information Systems; Geological Surveys; Geography; Technology Utilization

19990040961 NASA Goddard Space Flight Center, Greenbelt, MD USA
The Role of Metadata Standards in EOSDIS Search and Retrieval Applications
Pfister, Robin, NASA Goddard Space Flight Center, USA; [1999]; 3p; In English; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

Metadata standards play a critical role in data search and retrieval systems. Metadata tie software to data so the data can be processed, stored, searched, retrieved and distributed. Without metadata these actions are not possible. The process of populating metadata to describe science data is an important service to the end user community so that a user who is unfamiliar with the data, can easily find and learn about a particular dataset before an order decision is made. Once a good set of standards are in place, the accuracy with which data search can be performed depends on the degree to which metadata standards are adhered during product definition. NASA's Earth Observing System Data and Information System (EOSDIS) provides examples of how metadata standards are used in data search and retrieval.
Author
Data Management; Data Retrieval; Information Systems

19990041015 Bionetics Corp., Cocoa Beach, FL USA
Online Hazard Communication
Woodard, Daniel, Bionetics Corp., USA; Proceedings from the 1998 Occupational Health Conference: Benchmarking for Excellence; February 1999, pp. 201-202; In English; See also 19990040967; No Copyright; Avail: CASI; A01, Hardcopy; A03, Microfiche

Kennedy Space Center has established an online Material Safety Data Sheet (MSDS) archive accessible by personnel at NASA Centers using a standard Web browser, with URL http://msds.ksc.nasa.gov. The site permits searches for MSDSs available by automated fax from an archive maintained by the Base Operations Contractor. Users may also search MSDSs available online in full text, or find links to manufacturer's MSDS web sites. We hope to persuade more manufacturers of chemical products to provide hazard communication information directly on the Internet, and to persuade NASA contractors to facilitate Internet access from the work site. The most efficient communication is that which allows information to flow directly from the original author to the final user.
Derived from text
On-Line Systems; Information Retrieval; Information Flow; Hazards; Safety; Data Bases

89
ASTRONOMY

Includes radio, gamma-ray, and infrared astronomy, and astrometry.

19990039650 Space Telescope Science Inst., Baltimore, MD USA
High-Resolution Spectroscopy of some very Active Southern Stars
Soderblom, David R., Space Telescope Science Inst., USA; King, Jeremy R., Space Telescope Science Inst., USA; Henry, Todd J., Harvard-Smithsonian Center for Astrophysics, USA; Astronomical Journal; July 1998; Volume 116, pp. 396-413; In English
Contract(s)/Grant(s): NAGw-3695; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

We have obtained high-resolution echelle spectra of 18 solar-type stars that an earlier survey showed to have very high levels of Ca II H and K emission. Most of these stars belong to close binary systems, but five remain as probable single stars or well-separated binaries that are younger than the Pleiades on the basis of their lithium abundances and H.alpha emission. Three of these probable single stars also lie more than 1 mag above the main sequence in a color-magnitude diagram, and appear to have ages of 10 to 15 Myr. Two of them, HD 202917 and HD 222259, also appear to have a kinematic association with the pre-main-sequence multiple system HD 98800.
Author
Pre-Main Sequence Stars; Pleiades Cluster; Binary Stars; Stellar Systems; Star Formation

19990039651 Space Telescope Science Inst., Baltimore, MD USA
The Problem of Hipparcos Distances to Open Clusters. II. Constraints from Nearby Field Theory, Report 2, ClustersConstraints from nearly Field Stars
Soderblom, David R., Space Telescope Science Inst., USA; King, Jeremy R., Space Telescope Science Inst., USA; Hanson, Robert B., California Univ., USA; Jones, Burton F., California Univ., USA; Fischer, Debra, San Francisco State Univ., USA; Stauffer, John R., Harvard-Smithsonian Center for Astrophysics, USA; Pinsonneault, Marc H., Ohio State Univ., USA; Astrophysical Journal; Sep. 01, 1998; Volume 504, pp. 192-199; In English
Contract(s)/Grant(s): NAGw-4837; NAG5-4830; NSF AST-95-30632; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

This paper examines the discrepancy between distances to nearby open clusters as determined by parallaxes from Hipparcos compared to traditional main-sequence fitting. The biggest difference is seen for the Pleiades, and our hypothesis is that if the Hipparcos distance to the Pleiades is correct, then similar subluminous zero-age main-sequence (ZAMS) stars should exist elsewhere, including in the immediate solar neighborhood. We examine a color-magnitude diagram of very young and nearby solar-type stars and show that none of them lie below the traditional ZAMS, despite the fact that the Hipparcos Pleiades parallax would place its members 0.3 mag below that ZAMS. We also present analyses and observations of solar-type stars that do lie below the ZAMS, and we show that they are subluminous because of low metallicity and that they have the kinematics of old stars.
Author
Main Sequence Stars; Pleiades Cluster; Hipparcos Satellite; Stellar Parallax; Star Formation; Early Stars

19990039652 Space Telescope Science Inst., Baltimore, MD USA
HD 98800: A Unique Stellar System of Post-T Tauri Stars
Soderblom, David R., Space Telescope Science Inst., USA; King, Jeremy R., Space Telescope Science Inst., USA; Siess, Lionel, Observatoire de Grenoble, France; Noll, Keith S., Space Telescope Science Inst., USA; Gilmore, Diane M., Space Telescope Science Inst., USA; Henry, Todd J., Space Telescope Science Inst., USA; Nelan, Edmund, Space Telescope Science Inst., USA; Burrows, Christopher J., Space Telescope Science Inst., USA; Brown, Robert A., Space Telescope Science Inst., USA; Perryman, M. A. C., European Space Agency. European Space Research and Technology Center, ESTEC, Netherlands; Benedict, G. Fritz, McDonald Observatory, USA; McArthur, Barbara J., McDonald Observatory, USA; Franz, Otto G., Lowell Observatory, USA; Wasserman, Laurence H., Lowell Observatory, USA; Jones, Burton F., California Univ., USA; Latham, David W., Harvard-Smithsonian Center for Astrophysics, USA; Torres, Guillermo, Harvard-Smithsonian Center for Astrophysics, USA; Stefanik, Robert P., Harvard-Smithsonian Center for Astrophysics, USA; Astrophysical Journal; May 01, 1998; Volume 498, pp. 385-393; In English; Sponsored in part by the French Ministry of Foreign Affairs
Contract(s)/Grant(s): NAGw-4837; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

HD 98800 is a system of four stars, and it has a large infrared excess that is thought to be due to a dust disk within the system. In this paper we present new astrometric observations made with Hipparcos, as well as photometry from Hubble Space Telescope WFPC2 images. Combining these observations and reanalyzing previous work allow us to estimate the age and masses of the stars in the system. Uncertainty in these ages and masses results from uncertainty in the temperatures of the stars and any reddening they may have. We find that HD 98800 is most probably about 10 Myr old, although it may be as young as 5 Myr or as old as 20

Myr old. The stars in HD 98800 appear to have metallicities that are about solar. An age of 10 Myr means that HD 98800 is a member of the post T Tauri class of objects, and we argue that the stars in HD 98800 can help us understand why post T Tauris have been so elusive, HD 98800 may have formed in the Centaurus star-forming region, but it is extraordinary in being so young and yet so far from where it was born.
Author
Stellar Systems; Star Formation; Pre-Main Sequence Stars

19990039653 Space Telescope Science Inst., Baltimore, MD USA
The Age-Related Properties of the HD 98800 System
Soderblom, David R., Space Telescope Science Inst., USA; Henry, Todd J., Space Telescope Science Inst., USA; Shetrone, Matthew D., California Univ., USA; Jones, Burton F., California Univ., USA; Saar, Steven H., Harvard-Smithsonian Center for Astrophysics, USA; Astrophysical Journal; Apr. 01, 1996; Volume 460, pp. 984-992; In English
Contract(s)/Grant(s): NAGw-4837; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

We present optical spectroscopy of the field K star system HD 98800, which has been found to have significant infrared emission from circumstellar material. The lithium abundances of the stars in HD 98800 are well above those of Pleiades of similar color, but activity levels and rotation in these stars are at or below Pleiades level. Thus, it is not yet possible to say whether HD 98800 is or is not a pre-main-sequence system, and it is possible that its components are on or near the zero-age main sequence. However, the two visible objects that make up HD 98800 both have high levels of lithium and activity, strongly suggesting that they are physically related to one another. As shown by Torres and coworkers, having these stars physically tied implies that their relative orbit is highly eccentric and highly inclined to our line of sight, and it also means that we are viewing the HD 98800 system at an unusual time in its orbit.
Author
K Stars; Pleiades Cluster; Main Sequence Stars; Stellar Envelopes

19990040527 NASA Goddard Space Flight Center, Greenbelt, MD USA
An Alternative Lunar Ephemeris Model for On-Board Flight Software Use
Simpson, David G., NASA Goddard Space Flight Center, USA; [1998]; 10p; In English; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

In calculating the position vector of the Moon in on-board flight software, one often begins by using a series expansion to calculate the ecliptic latitude and longitude of the Moon, referred to the mean ecliptic and equinox of date. One then performs a reduction for precession, followed by a rotation of the position vector from the ecliptic plane to the equator, and a transformation from spherical to Cartesian coordinates before finally arriving at the desired result: equatorial J2000 Cartesian components of the lunar position vector. An alternative method is developed here in which the equatorial J2000 Cartesian components of the lunar position vector are calculated directly by a series expansion, saving valuable on-board computer resources.
Author
Moon; Position (Location); Ephemerides; Precession

19990040542 Naval Research Lab., Washington, DC USA
Eclipse Timings of the Low-Mass X-Ray Binary EXO 0748-676. II. Detection of an Apparent Orbital Period Change and of Orbital Period Noise, Report 2, Detection of an Apparent Orbital Period Change and of Orbital Period Noise
Hertz, Paul, Naval Research Lab., USA; Wood, Kent S., Naval Research Lab., USA; Cominsky, Lynn R., Sonoma State Univ., USA; Astrophysical Journal; Sep. 10, 1997; Volume 486, pp. 1000-1005; In English
Contract(s)/Grant(s): NAG5-3324; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

The rare eclipsing low-mass X-ray binary EXO 0748-676 has now been monitored accurately for over a decade in the hope of detecting orbital period evolution. We report observations of 10 complete eclipses at resolution less than 0.1 s with the Rossi X-ray Timing Explorer during 1996 May and 1996 August. We have timed the eclipses with an accuracy limited by photon statistics to 0.2-0.5 s. When combined with historical measurements, the eclipse timings imply an unexpectedly large orbital period derivative, P(sub orb) = 3.3 x 10(exp -11), and a rapid timescale for orbital evolution, tau(sub orb) = 1.3 x 10(exp 7) yr. The

observations also require considerable intrinsic jitter in the mideclipse timings; a maximum likelihood estimate is 0.15 s per orbital cycle. We consider various models and scenarios that might account for these unexpected results.
Author
X Ray Binaries; Eclipsing Binary Stars; X Ray Astronomy; X Ray Timing Explorer; Observation

19990040545 NASA Marshall Space Flight Center, Huntsville, AL USA
Discovery of a Magnetar Associated with the Soft Gamma Repeater SGR 1900+14
Kouveliotou, C., Universities Space Research Association, USA; Strohmayer, T., NASA Goddard Space Flight Center, USA; Hurley, K., California Univ., USA; vanParadus, J., Alabama Univ., USA; Finger, M. H., Universities Space Research Association, USA; Dieters, S., Alabama Univ., USA; Woods, P., Alabama Univ., USA; Thompson, C., North Carolina Univ., USA; Duncan, R. C., Texas Univ., USA; Astrophysical Journal; Jan. 10, 1999; Volume 510, pp. L115-L118; In English
Contract(s)/Grant(s): NAG5-2755; NAG5-3674; NAG5-4878; NAG5-32490; NAG5-4799; NAG5-3100; NAG5-4238; NAG5-4882; ARP-028; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

The soft gamma repeater SGR 1900+14 became active again in June 1998 after a long period of quiescence; it remained at a low state of activity until August 1998, when it emitted a series of extraordinarily intense outbursts. We have observed the source with the Rossi X-Ray Timing Explorer twice, during the onset of each active episode. We confirm the pulsations at the 5.16 s period reported earlier from SGR 1900+14. Here we report the detection of a secular spin-down of the pulse period at an average rate of 1.1 x 10(exp -10)s/s. In view of the strong similarities between SGRs, we attribute the spin-down of SGR 1900+14 to magnetic dipole radiation, possibly accelerated by a quiescent flux, as in the case of SGR 1806-20. This allows an estimate of the pulsar dipolar magnetic field, which is (2-8) x 10(exp 14) G. Our results confirm that SGRs are magnetars.
Author
Pulsars; X Ray Timing Explorer; Gamma Ray Sources (Astronomy); Gamma Ray Bursts; Supernova Remnants

19990040923 Arizona Univ., Steward Observatory, Tucson, AZ USA
A 2 THz Heterodyne Array Receiver for SOFIA, *1 May 1996 - 31 Jan. 1998*
Walker, Christopher K., Arizona Univ., USA; 1998; 1p; In English
Contract(s)/Grant(s): NAG2-1057; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

We proposed to perform a comprehensive design study of a 16-element heterodyne array receiver for SOFIA. The array was designed to utilize hot-electron bolometers in an efficient, low-cost waveguide mount to achieve low noise performance between approx. 1500 and 2400 GHz. Due to the prevailing physical conditions in the interstellar medium, this frequency range is one of the richest in the FIR portion of the spectrum. An array designed for this wavelength range will make excellent use of the telescope and the available atmospheric transmission, and will provide a new perspective on stellar, chemical, and galaxy evolution in the present as well as past epochs. A few of the most important molecular and atomic species which the instrument will sample are CII, OI, CO, OH, NII, and CH. The system used the most sensitive detectors available in an efficient optical system. The local oscillator was a compact CO2 pumped far-infrared laser currently under development for SOFIA. The backend spectrometer was an array acousto-optic spectrometer (aAOS). The spectrometer utilizes proven hardware and technologies to provide broadband performance (greater than or equal to 1 GHz per AOS channel) and high spectral resolution (1 MHz) with the maximum sensitivity and minimum complexity and cost. The proposed instrument would be the fastest and most sensitive heterodyne receiver ever to operate in the 1.5 - 2.4 THz band. One of the key technologies developed for the proposed instrument is the laser micromachining of waveguide structures. These structures provide both the optical link between the instrument and the telescope (via an array of efficient feedhorns) and the impedance transformation between the detectors and free space. With the assistance of funds provided from this grant, we were able to fabricate and test the world's first laser micromachined feedhorns. Figure 1 is a photograph of the 2 THz double feedhorn structure designed and constructed under the auspices of this grant. The quality of the waveguide structure is far better than that obtainable using any other fabrication technique. Figure 2 is the beam pattern obtained from it. The beam parameters are an excellent match to what is expected from theory. The success of this experiment demonstrates the viability of using laser micromachined components in the development of high performance, large format array receivers. Figure 3 is an illustration of the focal plane array concept we developed lot- SOFIA base upon this work. Un- fortunately, our instrument proposal was not selected as a first generation SOFIA instrument. However, we have continued our development efforts and will propose to build a 2nd generation instrument based on the same design concepts. Our work under NAG 2-1057 was very rewarding and we appreciate the opportunity provided by NASA to pursue it. The research led directly to publishing 2 papers (listed below) and the award of an NSF grant to our group to construct a laser micromachining system on the University of Arizona campus.
Author
Design Analysis; Heterodyning; Arrays; Receivers; Hot Electrons; Bolometers; Low Noise; Antenna Feeds; Fabrication

19990041045 NASA Marshall Space Flight Center, Huntsville, AL USA

An Unusual Supernova in the Error Box of the Gamma-Ray Burst of 25 April 1998

Galama , T. J., Amsterdam Univ., Netherlands; Vreeswijk, P. M., Amsterdam Univ., Netherlands; vanParadijs, J., Amsterdam Univ., Netherlands; Kouveliotou, C., NASA Marshall Space Flight Center, USA; Augusteijn, T., European Southern Observatory, Chile; Boehnhardt, H., European Southern Observatory, Chile; Brewer, J. P., European Southern Observatory, Chile; Doublier, V., European Southern Observatory, Chile; Gonzalez, J.-F., European Southern Observatory, Chile; Leibundgut, B., European Southern Observatory, Chile; Lidman, C., European Southern Observatory, Chile; Hainaut, O. R., European Southern Observatory, Chile; Patat, F., European Southern Observatory, Chile; Heise, J., Space Research Organization Netherlands, Netherlands; int-Zand, J., Space Research Organization Netherlands, Netherlands; Hurley, K., California Univ., USA; Groot, P. J., Amsterdam Univ., Netherlands; Strom, R. G., Amsterdam Univ., Netherlands; Mazzali, P. A., Osservatorio Astronomico, Italy; Iwamoto, K., Osservatorio Astronomico, Italy; Nature; Oct. 15, 1999; Volume 395, pp. 670-672; In English; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

The discovery of afterglows associated with gamma-ray bursts at X-ray, optical and radio wavelengths and the measurement of the redshifts of some of these events has established that gamma-ray bursts lie at extreme distances, making them the most powerful photon-emitters known in the Universe. Here we report the discovery of transient optical emission in the error box of the gamma-ray burst GRB980425, the light curve of which was very different from that of previous optical afterglows associated with gamma-ray bursts. The optical transient is located in a spiral arm of the galaxy ESO 184-GS2, which has a redshift velocity of only 2,550 km/ s. Its optical spectrum and location indicate that it is a very luminous supernova, which has been identified as SN1998bw. If this supernova and GRB980425 are indeed associated, the energy radiated in gamma-rays is at least four orders of magnitude less than in other gamma-ray bursts, although its appearance was otherwise unremarkable: this indicates that very different mechanisms can give rise to gamma-ray bursts. But independent of this association, the supernova is itself unusual, exhibiting an unusual light curve at radio wavelengths that requires that the gas emitting the radio photons be expanding relativistically.

Author

Supernovae; Gamma Rays; Spiral Galaxies; Red Shift; Light Curve; Errors; Afterglows

19990041047 Ohio State Univ., Astronomy Dept., Columbus, OH USA

The Problem of Hipparcos Distances to Open Clusters, Report 1, Constraints from Multicolor a Main-Sequence Fitting

Pinsonneault, Marc H., Ohio State Univ., USA; Stauffer, John, Harvard-Smithsonian Center for Astrophysics, USA; Soderblom, David R., Space Telescope Science Inst., USA; King, Jeremy R., Space Telescope Science Inst., USA; Hanson, Robert B., Lick Observatory, USA; Astrophysical Journal; Sep. 01, 1998; Volume 504, pp. 170-191; In English

Contract(s)/Grant(s): NAGw-4837; NAG5-4830; NSF ATS-95-30632; NAGw-2698; NAG5-3363; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

Parallax data from the Hipparcos mission allow the direct distance to open clusters to be compared with the distance inferred from main-sequence (MS) fitting. There are surprising differences between the two distance measurements. indicating either the need for changes in the cluster compositions or reddening, underlying problems with the technique of MS fitting, or systematic errors in the Hipparcos parallaxes at the 1 mas level. We examine the different possibilities, focusing on MS fitting in both metallicity-sensitive B-V and metallicity-insensitive V-I for five well-studied systems (the Hyades, Pleiades, alpha Per, Praesepe, and Coma Ber). The Hipparcos distances to the Hyades and alpha Per are within 1 sigma of the MS-fitting distance in B-V and V-I, while the Hipparcos distances to Coma Ber and the Pleiades are in disagreement with the MS-fitting distance at more than the 3 sigma level. There are two Hipparcos measurements of the distance to Praesepe; one is in good agreement with the MS-fitting distance and the other disagrees at the 2 sigma level. The distance estimates from the different colors are in conflict with one another for Coma but in agreement for the Pleiades. Changes in the relative cluster metal abundances, age related effects, helium, and reddening are shown to be unlikely to explain the puzzling behavior of the Pleiades. We present evidence for spatially dependent systematic errors at the 1 mas level in the parallaxes of Pleiades stars. The implications of this result are discussed.

Author

Parallax; Data Acquisition; Hipparcos Satellite; Dimensional Measurement; Distance; Estimates; Systematic Errors; Open Clusters

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ASTROPHYSICS

Includes cosmology; celestial mechanics; space plasmas; and interstellar and interplanetary gases and dust. For related information see also 75 Plasma Physics.

19990039132 Department of Energy, Office of Energy Research, Washington, DC USA
Search for the H-dibaryon. A proposal to E871
Fitch, V., Department of Energy, USA; Klein, J., Department of Energy, USA; May, M., Department of Energy, USA; Dec. 31, 1998; 21p; In English
Report No.(s): DE98-006508; DOE/ER/71019-T5-PT.3C; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

This report consists of vugraphs for a lecture on the search for the H-dibaryon. The physics importance of this search are: (1) low energy test of QCD; (2) new form of matter; (3) missing link between normal hadronic matter and strange matter; (4) astrophysical explanations; and (5) cosmology and dark matter. The author reviews past experiments searching for H-dibaryon. Finally he discusses search methods at E871.
NTIS
Baryons; Dark Matter; Particle Decay; Hadrons; Weak Energy Interactions

19990039603 Department of Energy, Office of Energy Research, Washington, DC USA
Discovery of high-redshift supernovae and their cosmological implications
Kim, A. G., Department of Energy, USA; Sep. 30, 1997; 93p; In English
Report No.(s): DE98-052837; LBNL-40840; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

In this thesis, the author discusses the methodology for doing photometry: from procedure of extracting supernova counts from images that contain combined supernova plus galaxy flux, to standard star calibration, to additional instrumental corrections that arise due to the multiple telescopes used for observations. He discusses the different sources of photometric error and their correlations, and the construction of the covariance matrix for all the points in the light curve. He then describes the K corrections which account for the redshifting of spectra that are necessary to compare the photometry of the high-redshift data with those from nearby (z less than 0.1) supernovae. Finally, he uses the first seven of the supernovae to test the hypothesis that they live in an under-dense bubble where the locally measured Hubble constant differs significantly from the true Hubble constant. He also uses the data to place limits on the value of the Hubble constant.
NTIS
Red Shift; Supernovae; Cosmology

19990039629 Department of Energy, Washington, DC USA
PG 0946+301: the Rosetta Stone of BALQSOs
Arav, N., Department of Energy, USA; Jun. 30, 1998; 10p; In English; Structure and Kinematics of Quasar Broad Line Regions, USA
Report No.(s): DE98-058605; UCRL-JC-131026; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

We describe the motivation and features of a multiwavelength spectroscopic campaign on broad absorption line (BAL) QSO PG 0946+301. The main goal of this project is to determine the ionization equilibrium and abundances (IEA) in BAL outflows. Previous studies of IEA in BALQSOs were based on the assumption that the BALs are not saturated so that the column densities inferred from the apparent optical depths are realistic. This critical assumption is at odds with several recent observations and with analysis of existing data which indicate that the absorption troughs are heavily saturated even when they are not black. In addition, X-ray observations, which are important for constraining the ionizing continuum, were not available for those objects that had UV spectral data. Quantifying the level of saturation in the BALs necessitates UV spectroscopy with much higher S/N and broader-spectral coverage than currently exist. After taking into account the capabilities of available observatories, our best hope for a substantial improvement in understanding the IEA in BALQSOs is to concentrate considerable observational resources on the most promising object. Our studies of available HST and ground-based spectra show that PG 0946+301 is by far the best candidate for such a program. This BALQSO is at least five times brighter, shortward of 1000 Angstrom, rest frame, than any other object, and due to its low redshift it has an especially sparse Ly(alpha) forest. At the same time PG 0946+301 is a typical BALQSO and therefore its IEA should be representative. to this effect we are developing a multiwavelength spectroscopic campaign (UV, FUV,

X-ray and optical) on BALQSO PG 0946+301. We discuss the goals and feasibility of each observational component: HST, FUSE, ASCA and ground-based.
NTIS
Absorption Spectra; Quasars; Ultraviolet Spectroscopy; Line Spectra; Ionization

19990041041 NASA Marshall Space Flight Center, Huntsville, AL USA
Further Evidence of Microfossils in Carbonaceous Chondrites
Hoover, Richard B., NASA Marshall Space Flight Center, USA; Rozanov, Alexei Yu., Russian Academy of Natural Sciences, Russia; Zhmur, S. I., Russian Academy of Natural Sciences, Russia; Gorlenko, V. M., Russian Academy of Natural Sciences, Russia; SPIE Proceedings Series; 1998; Volume 3441, pp. 203-216; In English; Instruments, Methods and Missions for Astrobiology, 20-22 Jul. 1998, San Diego, CA, USA; Sponsored by International Society for Optical Engineering, USA; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

Scanning electron microscopy investigations carried out independently in the USA and Russia have yielded further evidence of microfossils in meteorites. Numerous complex biomorphic microstructures representing possible microfossils have been found in interior surfaces of freshly broken samples of the Murchison, Orgueil, and Efremovka carbonaceous chondrites. Similar biomorphic forms were not encountered during comparable investigations of the Nikolskoye meteorite. Energy Dispersive Spectroscopy (EDS) and Link microprobe analysis provides elemental distributions indicating many of the microstructures have a carbon enhancement that is superimposed upon composition of the meteoritic matrix. The in-situ mineralized biomorphic microstructures found embedded in freshly fractured meteoritic surfaces are not considered to be recent surface contaminants. Environmental Scanning Electron Microscope (ESEM) in the US and SEM studies in Russia on different samples of carbonaceous chondrites revealed many spherical bodies (some with spikes) similar in size and shape to the forms of uncertain biogenicity designated ”organized elements” by prior workers. These studies also revealed the presence of far more complex bodies in carbonaceous chondrites. Numerous biomorphic microstructures were found which exhibit morphology, size, distribution and chemical composition that is consistent with the lithified remains of microorganisms (i.e. microfossils). We have observed characteristics indicative of biology, including evidence for colonial distribution, cell-walls, and close associations of forms exhibiting diverse aspects, known from living and fossil microbes, representing motile, reproductive, and life cycle developmental stages. Many of the meteoritic microstructures are very similar to microfossils of cyanobacteria, such as we have found in Cambrian phosphate-rich rocks (phosphorites) of Khubsugul, Northern Mongolia and high carbon Phanerozoic and Precambrian rocks (oil shales and black shales) of the Siberian and Russian Platforms. We have interpreted these complex microstructures in carbonaceous chondrites to represent the lithified remains of prokaryotic microorganisms including coccoidal and filiform cyanobacteria. We present images of these possible microfossils found in the Murchison, Efremovka, and Orgueil meteorites and compare these forms with known microorganisms and microfossils.
Author
Fossils; Meteoritic Microstructures; Bacteria; Cells (Biology); Chemical Composition; Chondrites

19990041043 National Academy of Sciences - National Research Council, Committee on Planetary and Lunar Exploration, Washington, DC USA
The Exploration of Near-Earth Objects
1998; 46p; In English
Contract(s)/Grant(s): NASw-96013; ISBN 0-309-06083-4; Copyright; Avail: Issuing Activity (Space Studies Board, National Research Council, 2101 Constitution Ave., NW, Washington, DC 20418), Hardcopy, Microfiche

Near-Earth objects (NEOs) are asteroids and comets with orbits that intersect or pass near that of our planet. About 400 NEOs are currently known, but the entire population contains perhaps 3000 objects with diameters larger than 1 km. These objects, thought to be similar in many ways to the ancient planetesimal swarms that accreted to form the planets, are interesting and highly accessible targets for scientific research. They carry records of the solar system’s birth and the geologic evolution of small bodies in the interplanetary region. Because collisions of NEOs with Earth pose a finite hazard to life, the exploration of these objects is particularly urgent. Devising appropriate risk-avoidance strategies requires quantitative characterization of NEOS. They may also serve as resources for use by future human exploration missions. The scientific goals of a focused NEO exploration program are to determine their orbital distribution, physical characteristics, composition, and origin. Physical characteristics, such as size, shape, and spin properties, have been measured for approximately 80 NEOs using observations at infrared, radar, and visible wavelengths. Mineralogical compositions of a comparable number of NEOs have been inferred from visible and near-infrared spectroscopy. The formation and geologic histories of NEOs and related main-belt asteroids are currently inferred from studies of meteorites and from Galileo and Near-Earth Asteroid Rendezvous spacecraft flybys of three main-belt asteroids. Some progress has also been made in associating specific types of meteorites with main-belt asteroids, which probably are the parent bodies of

most NEOs. The levels of discovery of NEOs in the future will certainly increase because of the application of new detection systems. The rate of discovery may increase by an order of magnitude, allowing the majority of Earth-crossing asteroids and comets with diameters greater than 1 km to he discovered in the next decade. A small fraction of NEOs are particularly accessible for exploration by spacecraft. To identify the exploration targets of highest scientific interest, the orbits and classification of a large number of NEOs should be determined by telescopic observations. Desired characterization would also include measurements of size, mass, shape, surface composition and heterogeneity, gas and dust emission, and rotation. Laboratory studies of meteorites can focus NEO exploration objectives and quantify the information obtained from telescopes. Once high-priority targets have been identified, various kinds of spacecraft missions (flyby, rendezvous, and sample return) can be designed. Some currently operational (Near-Earth Asteroid Rendezvous [NEAR]) or planned (Deep Space 1) U.S. missions are of the first two types, and other planned U.S. and Japanese spacecraft missions will return samples. Rendezvous missions with sample return are particularly desirable from a scientific perspective because of the very great differences in the analytical capabilities that can be brought to bear in orbit and in the laboratory setting. Although it would be difficult to justify human exploration of NEOs on the basis of cost-benefit analysis of scientific results alone, a strong case can be made for starting with NEOs if the decision to carry out human exploration beyond low Earth orbit is made for other reasons. Some NEOs are especially attractive targets for astronaut missions because of their orbital accessibility and short flight duration. Because they represent deep space exploration at an intermediate level of technical challenge, these missions would also serve as stepping stones for human missions to Mars. Human exploration of NEOs would provide significant advances in observational and sampling capabilities. With respect to ground based telescopic studies, the recommended baseline is that NASA and other appropriate agencies suupport research programs for interpreting the spectra of near-Earth objects (NEOs), continue and coordinate currently supported surveys to discover and determine the orbits of NEOs and develop policies for the public disclosure of results relating to potential hazards. Augmentation to this baseline program include in priority order: (1) provide routine or priority access to existiing ground-based optical and infrared telescopes and radar facilities for characterization of NEOs during favorable encounters; or (2) provide expanded, dedicated telescope access for characterization of NEOs. Appropriate augmentations to existing programs include the following: (1) Develop technological advances in spacecraft capabilities, including nonchemical propulsion and autonomous navigation systems, low-power and low-mass anlaytical instrumentation for remote and in situ studies, and multiple penetrators and other sampling and sample-handling systems to allow low-cost rendezvous and sample return missions; and (2) study technical requirements for human expeditions to NEOs. Although studies evaluating the risk of asteroid collisions with Earth and the means of averting them are desirable, they are beyond the scope of this report.

Author

Flyby Missions; Space Exploration; Space Surveillance (Ground Based); Asteroid Detection; Asteroids; Meteorites; Comets; Space Observations (From Earth)

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LUNAR AND PLANETARY EXPLORATION

Includes planetology; and manned and unmanned flights. For spacecraft design or space stations see 18 Spacecraft Design, Testing and Performance.

19990040204 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA USA

Galileo Probe Measurements of Thermal and Solar Radiation Fluxes in the Jovian Atmosphere

Sromovsky, L. A., Wisconsin Univ., USA; Collard, A. D., Wisconsin Univ., USA; Fry, P. M., Wisconsin Univ., USA; Orton, G. S., Jet Propulsion Lab., California Inst. of Tech., USA; Lemmon, M. T., Arizona Univ., USA; Tomasko, M. G., Arizona Univ., USA; Freedman, R. S., NASA Ames Research Center, USA; Journal of Geophysical Research; Sep. 25, 1998; ISSN 0148-0227; Volume 103, No. E10, pp. 22,929-22,977; In English

Report No.(s): Paper-98JE01048; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

The Galileo probe net flux radiometer (NFR) measured radiation fluxes in Jupiter's atmosphere from about 0.44 to 14 bars, using five spectral channels to separate solar and thermal components. Onboard calibration results confirm that the NFR responded to radiation approximately as expected. NFR channels also responded to a superimposed thermal perturbation, which can be approximately removed using blind channel measurements and physical constraints. Evidence for the expected NH3 cloud was seen in the spectral character of spin-induced modulations of the direct solar beam signals. These results are consistent with an overlying cloud of small NH3 ice particles (0.5-0.75 microns in radius) of optical depth 1.5-2 at 0.5 microns. Such a cloud would have so little effect on thermal fluxes that NFR thermal channels provide no additional constraints on its properties. However, evidence for heating near 0.45 bar in the NFR thermal channels would seem to require either an additional opacity source beyond this small-particle cloud, implying a heterogeneous cloud structure to avoid conflicts with solar modulation results, or a change

in temperature lapse rate just above the probe measurements. The large thermal flux levels imply water vapor mixing ratios that are only 6% of solar at 10 bars, but possibly increasing with depth, and significantly subsaturated ammonia at pressures less than 3 bars. If deep NH3 mixing ratios at the probe entry site are 3-4 times ground-based inferences, as suggested by probe radio signal attenuation, then only half as much water is needed to match NFR observations. No evidence of a water cloud was seen near the 5-bar level. The 5-microns thermal channel detected the presumed NH4SH cloud base near 1.35 bars. Effects of this cloud were also seen in the solar channel upflux measurements but not in the solar net fluxes, implying that the cloud is a conservative scatterer of sunlight. The minor thermal signature of this cloud is compatible with particle radii near 3 gm, but it cannot rule out smaller particles. Deeper than about 3 bars, solar channels indicate unexpectedly large absorption of sunlight at wavelengths longer than 0.6 microns, which might be due to unaccounted-for absorption by NH3 between 0.65 and 1.5 microns.
Author
Galileo Probe; Solar Radiation; Thermal Radiation; Flux (Rate); Jupiter Atmosphere; Heat Flux

19990040406 NASA Ames Research Center, Moffett Field, CA USA
Mars Characterization for Future Missions ***Final Report***
Bridger, Alison F. C., San Jose State Univ., USA; Haberle, Robert M., NASA Ames Research Center, USA; 1999; 5p; In English; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

The purpose of this research project was to create statistical products which could of use to the engineering and scientific communities planning future missions to Mars. This has been accomplished. Using simulations of Mars' atmosphere under a variety of conditions, we have created statistical databases quantifying the behavior of Mars' atmosphere under a variety of conditions expected to be encountered on forthcoming missions. These data are now being incorporated into a new version of Mars-GRAM.
Author
Data Bases; Planing; Mars (Planet)

19990040424 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA USA
Galileo Probe Measurements of Thermal and Solar Radiation Fluxes in the Jovian Atmosphere
Sromovsky, L. A., Wisconsin Univ., USA; Collard, A. D., Wisconsin Univ., USA; Fry, P. M., Wisconsin Univ., USA; Orton, G. S., Jet Propulsion Lab., California Inst. of Tech., USA; Lemmon, M. T., Arizona Univ., USA; Tomasko, M. G., Arizona Univ., USA; Freedman, R. S., NASA Ames Research Center, USA; Journal of Geophysical Research; Sep. 25, 1998; ISSN 0148-0227; Volume 103, No. E10, pp. 22,929-22,977; In English
Report No.(s): Paper-98JE01048; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

The Galileo probe net flux radiometer (NFR) measured radiation fluxes in Jupiter's atmosphere from about 0.44 to 14 bars, using five spectral channels to separate solar and thermal components. Onboard calibration results confirm that the NFR responded to radiation approximately as expected. NFR channels also responded to a superimposed thermal perturbation, which can be approximately removed using blind channel measurements and physical constraints. Evidence for the expected NH3 cloud was seen in the spectral character of spin-induced modulations of the direct solar beam signals. These results are consistent with an overlying cloud of small NH3 ice particles (0.5-0.75 microns in radius) of optical depth 1.5-2 at 0.5 microns. Such a cloud would have so little effect on thermal fluxes that NFR thermal channels provide no additional constraints on its properties. However, evidence for heating near 0.45 bar in the NFR thermal channels would seem to require either an additional opacity source beyond this small-particle cloud, implying a heterogeneous-cloud structure to avoid conflicts with solar modulation results, or a change in temperature lapse rate just above the probe measurements. The large thermal flux levels imply water vapor mixing ratios that are only 6% of solar at 10 bars, but possibly increasing with depth, and significantly subsaturated ammonia at pressures less than 3 bars. If deep NH3 mixing ratios at the probe entry site are 3-4 times ground-based inferences, as suggested by probe radio signal attenuation, then only half as much water is needed to match NFR observations. No evidence of a water cloud was seen near the 5-bar level. The 5 microns thermal channel detected the presumed NH4SH cloud base near 1.35 bars. Effects of this cloud were also seen in the solar channel upflux measurements but not in the solar net fluxes, implying that the cloud is a conservative scatterer of sunlight. The minor thermal signature of this cloud is compatible with particle radii near 3 microns, but it cannot rule out smaller particles. Deeper than about 3 bars, solar channels indicate unexpectedly large absorption of sunlight at wavelengths longer than 0.6 microns, which might be due to unaccounted-for absorption by NH3 between 0.65 and 1.5 microns.
Author
Galileo Probe; Solar Radiation; Thermal Radiation; Heat Flux; Jupiter Atmosphere; Flow Measurement

19990040658 NASA Goddard Space Flight Center, Greenbelt, MD USA
MOLA Topographic Variations Along the Crustal Dichotomy Boundary Zone in Eastern and Western Mars
Frey, H, NASA Goddard Space Flight Center, USA; Sakimoto, S., Universities Space Research Association, USA; Roark, J., Sci-

ence Systems and Applications, Inc., USA; 1999; 4p; In English; Lunar and Planetary Sciences, 15-18 Mar. 1999, Houston, TX, USA; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

The topographic character of the martian crustal dichotomy boundary zone changes along the boundary, as does the morphological character of the boundary itself. Overall the elevation change from lowland plains to cratered uplands has the character of a step function, but the magnitude of the step and the slope of the ramp in the transition zone between the two relatively flat surfaces is different in different areas. Especially prominent is the difference between the boundaries in Deuteronilus-Ismenius Lacus and in Tempe Terra: Total relief in the transition zone in central Tempe is significantly greater than that in most of the eastern boundary zone. The correlation of topography with changing morphological character and mapped geologic units suggests that different parts of the boundary had different modification histories, and, perhaps, different origins as well.

Author

Mars (Planet); Topography; Crusts; Dichotomies; Mars Surface; Boundaries

19990040659 NASA Goddard Space Flight Center, Greenbelt, MD USA

Discovery of a New Cassini-Size Basin on Mars from MOLA Topographic Data

Frey, H., NASA Goddard Space Flight Center, USA; Sakimoto, S., Universities Space Research Association, USA; Roark, J., Science Systems and Applications, Inc., USA; 1999; 2p; In English; Lunar and Planetary Sciences, 15-18 Mar. 1999, Houston, TX, USA; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

MOLA profile data collected during the Science Phasing Operations have revealed a previously unknown, 450 km wide, 2 km deep basin on Mars centered at 30N, 312W near the Phison Rupes. This structure, as large as and somewhat deeper than the very obvious Cassini impact basin located 1000 km to the SW, is not apparent in the existing good quality Viking imagery. Gridded MOLA data show the basin as a closed depression, but elevation contours show only weak correlation with what little structure exists in the area and with mapped geologic units. From analysis of slope breaks readily visible in two MOLA profiles we suggest this is at least a three-ring basin. Portions of rings from concentric fits to slope breaks align with some of the linear ridge-like structures of the Phison Rupes, and outline a region of lower crater density and smoother inter-crater plains. The discovery of such a pronounced topographic depression which lacks obvious visible structure suggests more such previously unknown features may exist on Mars, and that MOLA data may be useful in finding them.

Author

Topography; Mars Photographs; Craters

19990041042 National Academy of Sciences - National Research Council, Committee on Planetary and Lunar Exploration, Washington, DC USA

Exploring the Trans-Neptunian Solar System

1998; 66p; In English

Contract(s)/Grant(s): NASw-96013; ISBN 0-309-06041-9; Copyright; Avail: Issuing Activity (Space Studies Board, National Research Council, 2101 Constitution Ave., NW, Washington, DC 20418), Hardcopy, Microfiche

A profound question for scientists, philosophers and, indeed, all humans concerns how the solar system originated and subsequently evolved. to understand the solar system's formation, it is necessary to document fully the chemical and physical makeup of its components today, particularly those parts thought to retain clues about primordial conditions and processes.] In the past decade, our knowledge of the outermost, or trans-neptunian, region of the solar system has been transformed as a result of Earth-based observations of the Pluto-Charon system, Voyager 2's encounter with Neptune and its satellite Triton, and recent discoveries of dozens of bodies near to or beyond the orbit of Neptune. As a class, these newly detected objects, along with Pluto, Charon, and Triton, occupy the inner region of a hitherto unexplored component of the solar system, the Kuiper Belt. The Kuiper Belt is believed to be a reservoir of primordial objects of the type that formed in the solar nebula and eventually accreted to form the major planets. The Kuiper Belt is also thought to be the source of short-period comets and a population of icy bodies, the Centaurs, with orbits among the giant planets. Additional components of the distant outer solar system, such as dust and the Oort comet cloud, as well as the planet Neptune itself, are not discussed in this report. Our increasing knowledge of the trans-neptunian solar system has been matched by a corresponding increase in our capabilities for remote and in situ observation of these distant regions. Over the next 10 to 15 years, a new generation of ground- and space-based instruments, including the Keck and Gemini telescopes and the Space Infrared Telescope Facility, will greatly expand our ability to search for and conduct physical and chemical studies on these distant bodies. Over the same time span, a new generation of lightweight spacecraft should become available and enable the first missions designed specifically to explore the icy bodies that orbit 30 astronomical units (AU) or more from the Sun. The combination of new knowledge, plus the technological capability to greatly expand this knowledge over the next decade or so, makes this a particularly opportune time to review current understanding of the trans-neptunian solar system and to begin planning for the future exploration of this distant realm. Based on current knowledge, studies of trans-neptunian objects are important for

a variety of reasons that can be summarized under five themes: (1) Exploration of new territory; (2) reservoirs of primitive materials; (3) Processes that reveal the solar system's origin and evolution; (4) Links to extrasolar planets; and (5) prebiotic chemistry. These five themes are not on an equal footing. The first three are well-established areas of scientific investigation and are backed up by a substantial body of observational and theoretical understanding. The last two, however are more speculative. They are included here because they raise a number of interesting possibilities that seem particularly suited to an interdisciplinary approach uniting planetary scientists with their colleagues in the astrophysical and life science communities. Although not considered in any detail in this report, the distant outer solar system also has direct relevance to Earth and the other terrestrial planets because it is the source of comets that bring volatiles into the inner solar system. The resulting inevitable impacts between comets and other planetary bodies can play major roles in the evolution of life as suggested by, for example, the Cretaceous-tertiary boundary bolide and the extinction of the dinosaurs.
Author
Extrasolar Planets; Gas Giant Planets; Kuiper Belt; Neptune (Planet); Solar System; Pluto (Planet); Astronomy; Solar System Evolution; Planetary Evolution; Triton; Charon; Planetary Composition; Space Exploration

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SOLAR PHYSICS

Includes solar activity, solar flares, solar radiation and sunspots. For related information see 93 Space Radiation.

19990039171 NASA Marshall Space Flight Center, Huntsville, AL USA
A Two-Fluid, MHD Coronal Model
Suess, S. T., NASA Marshall Space Flight Center, USA; Wang, A.-H., Alabama Univ., USA; Wu, S. T., Alabama Univ., USA; Poletto, G., Osservatorio di Firenze, Italy; McComas, D. J., Los Alamos National Lab., USA; Journal of Geophysical Research; Mar. 01, 1999; ISSN 0148-0227; Volume 104, No. A3, pp. 4697-4708; In English
Contract(s)/Grant(s): N00014-C-95-2058; NSF ATM-96-33629; NAGw-4665
Report No.(s): Paper-1998JA900086; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

We describe first results from a numerical two-fluid MHD model of the global structure of the solar Corona. The model is two-fluid in the sense that it accounts for the collisional energy exchange between protons and electrons. As in our single-fluid model, volumetric heat and Momentum sources are required to produce high speed wind from Corona] holes, low speed wind above streamers, and mass fluxes similar to the empirical solar wind. by specifying different proton and electron heating functions we obtain a high proton temperature in the coronal hole and a relatively low proton temperature above the streamer (in comparison with the electron temperature). This is consistent with inferences from SOHO/UltraViolet Coronagraph Spectrometer instrument (UVCS), and with the Ulysses/Solar Wind Observations Over the Poles of the Sun instrument (SWOOPS) proton and electron temperature measurements which we show from the fast latitude scan. The density in the coronal hole between 2 and 5 solar radii (2 and 5 R(sub S)) is similar to the density reported from SPARTAN 201.-01 measurements by Fisher and Guhathakurta [19941. The proton mass flux scaled to 1 AU is 2.4 x 10(exp 8)/sq cm s, which is consistent with Ulysses observations. Inside the closed field region, the density is sufficiently high so that the simulation gives equal proton and electron temperatures due to the high collision rate. In open field regions (in the coronal hole and above the streamer) the proton and electron temperatures differ by varying amounts. In the streamer the temperature and density are similar to those reported empirically by Li et al. [1998], and the plasma beta is larger than unity everywhere above approx. 1.5 R(sub S), as it is in all other MHD coronal streamer models [e.g., Steinolfson et al., 1982; also G. A. Gary and D. Alexander, Constructing the coronal magnetic field, submitted to Solar Physics, 1998].
Author
Mathematical Models; Magnetohydrodynamics; Solar Corona; Solar Magnetic Field; Collision Rates; Coronagraphs; Protons; Electron Energy; Solar Wind; Temperature Measurement; Two Fluid Models

19990040386 Department of Energy, Office of Energy Research, Washington, DC USA
Results of the whole GALLEX experiment
Cribier, M., Department of Energy, USA; Jan. 31, 1998; 10p; In English; 5th; Astroparticle and Underground Physics, USA
Report No.(s): DE98-003080; BNL-65069; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

After 5.5 years of data taking, GALLEX ended its experimental phase. The solar neutrino production rate, 76.4 +/- 8 SNU represents about 55% of the predicted rate. The As tests prove, at the 1% level, the reliability of the technique and the detection

of (sup 51)Cr neutrino, with the nominal efficiency (93.0 +/- 8%), control the response of the detector to neutrinos in the solar energy range.
NTIS
Data Processing; Radiation Detectors

19990040754 NASA Marshall Space Flight Center, Huntsville, AL USA
Comment on "The Predicted Size of Cycle 23 Based on the Inferred three-cycle Quasiperiodicity of the Planetary Index Ap"
Wilson, Robert M., NASA Marshall Space Flight Center, USA; Hathaway, David H., NASA Marshall Space Flight Center, USA; Journal of Geophysical Research; Feb. 01, 1999; ISSN 0148-0227; Volume 104, No. A2, pp. 2555-2558; In English
Report No.(s): Paper-1998JA900074; Copyright; Avail: Issuing Activity, Hardcopy, Microfiche

Recently, Ahluwalia reviewed the solar and geomagnetic data for the last 6 decades and remarked that these data "indicate the existence of a three-solar-activity-cycle quasiperiodicity in them." Furthermore, on the basis of this inferred quasiperiodicity, he asserted that cycle 23 represents the initial cycle in a new three-cycle string, implying that it "will be more modest (a la cycle 17) with an annual mean sunspot number count of 119.3 +/- 30 at the maximum", a prediction that is considerably below the consensus prediction of 160 +/- 30 by Joselin et al. and of similar predictions by others based on a variety of predictive techniques. Several major sticking points of Ahluwalia's presentation, however, must be readdressed, and these issues form the basis of this comment. First, Ahluwalia appears to have based his analysis on a data set of Ap index values that is erroneous. For example, he depicts for the interval of 1932-1997 the variation of the Ap index in terms of annual averages, contrasting them against annual averages of sunspot number (SSN), and he lists for cycles 17-23 the minimum and maximum value of each, as well as the years in which they occur and a quantity which he calls "Amplitude" (defined as the numeric difference between the maximum and minimum values). In particular, he identifies the minimum Ap index (i.e., the minimum value of the Ap index in the vicinity of sunspot cycle minimum, which usually occurs in the year following sunspot minimum and which will be called hereafter, simply, Ap min) and the year in which it occur for cycles 17 - 23 respectively.
Derived from text
Data Acquisition; Solar Activity; Geomagnetism; Sunspot Cycle

19990041068 NASA Goddard Space Flight Center, Greenbelt, MD USA
Quiet-Time Spectra and Abundances of Energetic Particles During the 1996 Solar Minimum
Reames, Donald V., NASA Goddard Space Flight Center, USA; Jun. 1999; 24p; In English; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

We report the energy spectra and abundances of ions with atomic number, Z, in the interval Z is greater than or equal to 2 and Z is less than or equal to 36 and energies approximately 3-20 MeV/amu for solar and interplanetary quiet periods between 1994 November and 1998 April as measured by the large-geometry Low Energy Matrix Telescope (LEMT) telescope on the Wind spacecraft near Earth. The energy spectra show the presence of galactic (GCR) and "anomalous" cosmic ray (ACR) components, depending on the element. ACR components are reported for Mg and Si for the first time at 1 AU and the previous observation of S and Ar is confirmed. However, only GCR components are clearly apparent for the elements Ca, Ti, Cr, Fe, as well as for C. New limits are placed on a possible ACR contribution for other elements, including Kr.
Author
Abundance; Cosmic Rays; Solar Activity Effects; Galactic Cosmic Rays; Interstellar Matter; Particle Acceleration

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SPACE RADIATION

Includes cosmic radiation; and inner and outer earth's radiation belts. For biological effects of radiation see 52 Aerospace Medicine. For theory see 73 Nuclear and High-Energy Physics.

19990039569 Department of Energy, Assistant Secretary for Management and Administration, Washington, DC USA
X-ray spectral properties of (gamma)-ray bursts
Strohmayer, T. E., Department of Energy, USA; Fenimore, E. E., Department of Energy, USA; Murakami, T., Department of Energy, USA; Yoshida, A., Department of Energy, USA; Sep. 30, 1997; 8p; In English; 4th; Huntsville Gamma Ray Bursts, USA
Report No.(s): DE98-002923; LA-UR-97-4393; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The authors summarize the spectral characteristics of a sample of 22 bright gamma-ray bursts detected with the gamma-ray burst sensors aboard the satellite Ginga. This instrument employed a proportional and scintillation counter to provide sensitivity

to photons in the 2--400 keV range, providing a unique opportunity to characterize the largely unexplored X-ray properties of gamma- ray bursts. The photon spectra of the Ginga bursts are well described by a low energy slope, a bend energy, and a high energy slope. In the energy range where they can be compared, this result is consistent with burst spectral analyses obtained from the BATSE experiment aboard the Compton Observatory. However, below 20 keV they find evidence for a positive spectral number index in approximately 40% of their burst sample, with some evidence for a strong rolloff at lower energies in a few events. They find that the distribution of spectral bend energies extends below 10 keV. The observed ratio of energy emitted in the X-rays relative to the gamma-rays can be much larger than a few percent and, in fact, is sometimes larger than unity. The average for their sample is 24%.
NTIS
Spectrum Analysis; Densimeters; X Rays; Spectra; Gamma Ray Bursts

19990040557 NASA Goddard Space Flight Center, Greenbelt, MD USA
EGRET Observations of the Diffuse Gamma-Ray Emission in Orion: Analysis Through Cycle 6
Digel, S. W., Universities Space Research Association, USA; Aprile, E., Columbia Univ., USA; Hunter, S. D., NASA Goddard Space Flight Center, USA; Mukherjee, R., Columbia Univ., USA; Xu, F., Columbia Univ., USA; 1999; 18p; In English
Contract(s)/Grant(s): NAG5-2823; NAG5-2872; NAG5-3696; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

We present a study of the high-energy diffuse emission observed toward Orion by the Energetic Gamma-Ray Experiment Telescope (EGRET) on the Compton Gamma-Ray Observatory. The total exposure by EGRET in this region has increased by more than a factor of two since a previous study. A simple model for the diffuse emission adequately fits the data; no significant point sources are detected in the region studied (1 = 195 deg to 220 deg and b = -25 deg to -10 deg) in either the composite dataset or in two separate groups of EGRET viewing periods considered. The gamma-ray emissivity in Orion is found to be (1.65 +/- 0.11) x 10(exp -26)/s.sr for E greater than 100 MeV, and the differential emissivity is well-described as a combination of contributions from cosmic-ray electrons and protons with approximately the local density. The molecular mass calibrating ratio is N(H2)/W(sub CO) = (1.35 +/- 0.15) x 10(exp 20)/sq cm.(K.km/s).
Author
Orion Nebula; Molecular Clouds; Interstellar Gas; Emission Spectra; Gamma Ray Spectra

19990040788 Los Alamos National Lab., NM USA
X-ray flashes in ROSAT PSPC data
Sun, X.; Li, H.; Fenimore, E. E.; Wang, Q. D.; Dec. 31, 1998; 6p; In English; 4th; Huntsville gamma ray bursts
Report No.(s): DE99-000633; LA-UR-98-307; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The authors find 24 short (200--2,500s) X-ray flashes from all the ROSAT Position Sensitive Proportional Counter (PSPC) observations above galactic latitude 30 degrees ((approximately) 9.6 Msec) and some observations toward low extraordinary. Its flux rises from nondetection by a factor of > 200 in less than 100 sec. Its spectrum can be fitted either by a thermal plasma model with kT (ge) 2.4 keV, or by a single power-law with the photon number index of (approx) (minus)1.7. Photon statistics are not sufficient to obtain spectra for other flashes. The flash event fields can vary from optically crowded regions to blank fields. Although eight flashes are found from observations from nearby galaxies, and three of them are within the optical extent of their corresponding galaxies, they could not statistically establish that there are two different populations between nearby galaxies and control fields.
NTIS
Photons; Proportional Counters; ROSAT Mission; Spectra; Thermal Plasmas; X Ray Irradiation

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