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**Scientific and Technical
Information Program Office**

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STAR subject coverage includes all aspects of aeronautics and space research and development, supporting basic and applied research, and applications. Aerospace aspects of Earth resources, energy development, conservation, oceanography, environmental protection, urban transportation, and other topics of high national priority are also covered.

Abstracts in *STAR* are categorized by 10 major subject divisions that are divided further into 76 specific subject categories. The subject divisions and categories are listed in the Table of Contents together with a note for each that defines its scope and provides any cross-references.

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Subject Divisions

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H. Physics
I. Social and Information Sciences
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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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Subject Categories of the Division A. Aeronautics

02 Aerodynamics 1

Includes aerodynamics of flight vehicles, test bodies, airframe components and combinations, wings, and control surfaces. Also includes aerodynamics of rotors, stators, fans and other elements of 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; aircraft ground operations; flight safety and hazards; and aircraft accidents. Systems and hardware specific to ground operations of aircraft and to airport construction are covered in *09 Research and Support Facilities (Air)*. Air traffic control is covered in *04 Aircraft Communications and Navigation*. For related information see also *16 Space Transportation and Safety*; and *85 Technology Utilization and Surface Transportation*.

04 Aircraft Communications and Navigation 6

Includes all modes of communication with and between aircraft; air navigation systems (satellite and ground based); and air traffic control. For related information see also *06 Avionics and Aircraft Instrumentation*; *17 Space Communications; Spacecraft Communications, Command and Tracking*, and *32 Communications and Radar.*

05 Aircraft Design, Testing and Performance 7

Includes all stages of design of aircraft and aircraft structures and systems. Also includes aircraft testing, performance, and evaluation, and aircraft and flight simulation technology. For related information, see also *18 Spacecraft Design, Testing and Performance* and *39 Structural Mechanics*. For land transportation vehicles, see *85 Technology Utilization and Surface Transportation*.

06 Avionics and Aircraft Instrumentation 11

Includes all avionics systems, cockpit and cabin display devices, and flight instruments intended for use in aircraft. For relatead information see also *04 Aircraft Communications and Navigation; 08 Aircraft Stability and Control; 19 Spacecraft Instrumentation and Astrionics; and 35 Instrumentation and Photography.*

07 Aircraft Propulsion and Power 11

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 13

Includes flight dynamics, aircraft handling qualities; piloting; flight controls; and autopilots. For related information, see also *05 Aircraft Design, Testing and Performance* and *06 Avionics and Aircraft Instrumentation*.

09 Research and Support Facilities (Air) 15

Includes airports, runways, hangers, and aircraft repair and overhaul facilities, wind tunnels, water tunnels, and shock tubes; flight simulators; and aircraft engine test stands. Also includes airport ground equipment and systems. For airport ground operation see *03 Air Transportation and Safety.* For astronautical facilities see *14 Ground Support Systems and Facilities (Space).*

Subject Categories of the Division B. Astronautics

12 Astronautics (General) 16

Includes general research topics related to space flight and manned and unmanned space vehicles, platforms or objects launched into, or assembled in, outer space; and related components and equipment. Also includes manufacturing and maintenance of such vehicles or platforms. For specific topics in astronautics see *categories 13 through 20*. For extraterrestrial exploration, see *91 Lunar and Planetary Science and Exploration*.

15 Launch Vehicles and Launch Operations 18

Includes all classes of launch vehicles, launch/space vehicle systems, and boosters; and launch operations. For related information see also *18 Spacecraft Design, Testing, and Performance; and 20 Spacecraft Propulsion and Power.*

17 Space Communications, Spacecraft Communications, Command and Tracking 19

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

18 Spacecraft Design, Testing and Performance 20

Includes satellites; space platforms; space stations; spacecraft systems and components such as thermal and environmental controls; and spacecraft control and stability characteristics. 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 and Safety.*

20 Spacecraft Propulsion and Power 23

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; 15 Launch Vehicles and Launch Operations;* and *44 Energy Production and Conversion*.

Subject Categories of the Division C. Chemistry and Materials

23 Chemistry and Materials (General) 23

Includes general research topics related to the composition, properties, structure, and use of chemical compounds and materials as they relate to aircraft, launch vehicles, and spacecraft. For specific topics in chemistry and materials see *categories 24 through 29*. For astrochemistry see category *90 Astrophysics*.

24 Composite Materials 32

Includes physical, chemical, and mechanical properties of laminates and other composite materials.

25 Inorganic, Organic, and Physical Chemistry 37

Includes the analysis, synthesis, and use inorganic and organic compounds; combustion theory; electrochemistry; and photochemistry. For related information see also *34 Fluid Dynamics and Thermodynamics, For astrochemistry see category 90 Astrophysics*.

26 Metals and Metallic Materials 44

Includes physical, chemical, and mechanical properties of metals and metallic materials; and metallurgy.

27 Nonmetallic Materials 54

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 72

Includes rocket propellants, igniters and oxidizers; their storage and handling procedures; and aircraft fuels. For nuclear fuels see *73 Nuclear Physics*. For related information see also *07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power*, and *44 Energy Production and Conversion*.

29 Space Processing 73

Includes space-based development of materials, compounds, and processes for research or commercial application. Also includes the development of materials and compounds in simulated reduced–gravity environments. For legal aspects of space commercialization see *84 Law, Political Science and Space Policy.*

Subject Categories of the Division D. Engineering

31 Engineering (General) 77

Includes general research topics to engineering and applied physics, and particular areas of vacuum technology, industrial engineering, cryogenics, and fire prevention. For specific topics in engineering see *categories 32 through 39*.

32 Communications and Radar 78

Includes radar; radio, 7wire, and optical communications; land and global communications; communications theory. 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 and Safety.*

33 Electronics and Electrical Engineering 82

Includes development, performance, and maintainability of electrical/electronic devices and components; related test equipment. and microelectronics and integrated circuitry. For related information see also *60 Computer Operations and Hardware;* and *76 Solid-State Physics*. For communications equipment and devices see *32 Communications and Radar.*

34 Fluid Mechanics and Thermodynamics 88

Includes fluid dynamics and kinematics and all forms of heat transfer; boundary layer flow; hydrodynamics; hydraulics; fluidics; mass transfer and ablation cooling. For related information see also *02 Aerodynamics.*

35 Instrumentation and Photography 94

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 Avionics and Aircraft Instrumentation;* and *19 Spacecraft Instrumentation*.

36 Lasers and Masers 97

Includes lasing theory, laser pumping techniques, maser amplifiers, laser materials, and the assessment of laser and maser outputs. For cases where the application of the laser or maser is emphasized see also the specific category where the application is treated. For related information see also *76 Solid-State Physics*.

37 Mechanical Engineering 98

Includes mechanical devices and equipment; machine elements and processes. For cases where the application of a device or the host vehicle is emphasized see also the specific category where the application or vehicle is treated. For robotics see *63 Cybernetics, Artificial Intelligence, and Robotics*; and *54 Man/System Technology and Life Support*.

38 Quality Assurance and Reliability 101

Includes approaches to, and methods for reliability analysis and control, inspection, maintainability, and standardization.

39 Structural Mechanics 101

Includes structural element design, analysis and testing; dynamic responses of structures; weight analysis; fatigue and other structural properties; and mechanical and thermal stresses in structure. For applications see *05 Aircraft Design, Testing and Performance* and *18 Spacecraft Design, Testing and Performance*.

Subject Categories of the Division E. Geosciences

42 Geosciences (General) 103

Includes general research topics related to the Earth sciences, and the specific areas of petrology, minerology, and general geology. For other specific topics in geosciences see *categories 42 through 48*.

43 Earth Resources and Remote Sensing 107

Includes remote sensing of earth features, phenomena and resources by aircraft, balloon, rocket, and spacecraft; analysis or remote sensing data and imagery; development of remote sensing products; photogrammetry; and aerial photographs. For instrumentation see *35 Instrumentation and Photography.*

44 Energy Production and Conversion 109

Includes specific energy conversion systems, e.g., fuel cells; and solar, geothermal, windpower, and waterwave conversion systems; energy storage; and traditional power generators. For technologies related to nuclear energy production see *73 Nuclear Physics*. For related information see also *07 Aircraft Propulsion and Power; 20 Spacecraft Propulsion and Power*, and *28 Propellants and Fuels*.

45 Environment Pollution 111

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46 Geophysics 120

Includes earth structure and dynamics, aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism. For related information see *47 Meteorology and Climatology;* and *93 Space Radiation*.

47 Meteorology and Climatology 124

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48 Oceanography 127

Includes the physical, chemical and biological aspects of oceans and seas; ocean dynamics, and marine resources. For related information see also *43 Earth Resources and Remote Sensing*.

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51 Life Sciences (General) 129

Includes general research topics related to plant and animal biology (non–human); ecology; microbiology; and also the origin, development, structure, and maintenance, of animals and plants in space and related environmental conditions. For specific topics in life sciences see *categories 52 through 55*.

52 Aerospace Medicine 142

Includes the biological and physiological effects of atmospheric and space flight (weightlessness, space radiation, acceleration, and altitude stress) on the human being; and the prevention of adverse effects on those environments. For psychological and behavioral effects of aerospace environments see *53 Behavioral Sciences*. For the effects of space on animals and plants see *51 Life Sciences*.

53 Behavioral Sciences 147

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

54 Man/System Technology and Life Support 149

Includes human factors engineering; bionics, man–machine, life support, space suits and protective clothing. For related information see also *16 Space Transportation* and *52 Aerospace Medicine*..

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60 Computer Operations and Hardware 166

Includes hardware for computer graphics, firmware and data processing. For components see *33 Electronics and Electrical Engineering*. For computer vision see *63 Cybernetics, Artificial Intelligence and Robotics*.

61 Computer Programming and Software 167

Includes software engineering, computer programs, routines, algorithms, and specific applications, e.g., CAD/CAM. For computer software applied to specific applications, see also the associated category.

62 Computer Systems 172

Includes computer networks and distributed processing systems. For information systems see *82 Documentation and Information Science*. For computer systems applied to specific applications, see the associated category.

63 Cybernetics, Artificial Intelligence and Robotics 173

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

64 Numerical Analysis 174

Includes iteration, differential and difference equations, and numerical approximation.

65 Statistics and Probability 176

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

67 Theoretical Mathematics 176

Includes algebra, functional analysis, geometry, topology set theory, group theory and and number theory.

Subject Categories of the Division H. Physics

70 Physics (General) 177

Includes general research topics related to mechanics, kinetics, magnetism, and electrodynamics. For specific areas of physics see *categories 71 through 77*. For related instrumentation see *35 Instrumentation and Photography;* for geophysics, astrophysics or solar physics see *46 Geophysics*, *90 Astrophysics*, or *92 Solar Physics*.

71 Acoustics 178

Includes sound generation, transmission, and attenuation. For noise pollution see *45 Environment Pollution.* For aircraft noise see also *02 Aerodynamics* and *07 Aircraft Propulsion Propulsion and Power.*

72 Atomic and Molecular Physics 181

Includes atomic and molecular structure, electron properties, and atomic and molecular spectra. For elementary particle physics see *73 Nuclear Physics*.

73 Nuclear Physics 186

Includes nuclear particles; and reactor theory. For space radiation see *93 Space Radiation*. For atomic and molecular physics see *72 Atomic and Molecular Physics*. For elementary particle physics see *77 Physics of Elementary Particles and Fields*. For nuclear astrophysics see *90 Astrophysics*.

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76 Solid-State Physics **189**

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Includes general research topics related to sociology; educational programs and curricula.

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Includes management planning and research.

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

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89 Astronomy **215**

Includes observations of celestial bodies, astronomical instruments and techniques; radio, gamma-ray, x–ray, ultraviolet, and infrared astronomy; and astrometry.

90 Astrophysics **216**

Includes cosmology; celestial mechanics; space plasmas; and interstellar and interplanetary gases and dust.

91 Lunar and Planetary Science and Exploration **219**

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

92 Solar Physics **228**

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

93 Space Radiation **229**

Includes cosmic radiation; and inner and outer Earth radiation belts. For biological effects of radiation on plants and animals see *52 Aerospace Medicine*. For theory see *73 Nuclear Physics.*

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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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02
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Includes aerodynamics of flight vehicles, test bodies, airframe components and combinations, wings, and control surfaces. Also includes aerodynamics of rotors, stators, fans and other elements of turbomachinery. For related information, see also 34 Fluid Mechanics and Heat Transfer.

20010054457 NASA Langley Research Center, Hampton, VA USA
Parameter Sensitivity Study of the Wall Interference Correction System (WICS)
Walker, Eric L., NASA Langley Research Center, USA; Everhart, Joel L., NASA Langley Research Center, USA; Iyer, Venkit, Lockheed Martin Corp., USA; [2001]; 14p; In English; 19th AIAA Applied Aerodynamics Conference, 11-14 Jun. 2001, Anaheim, CA, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Report No.(s): AIAA Paper 2001-2421; Copyright Waived; Avail: CASI; A03, Hardcopy; A01, Microfiche

An off-line version of the Wall Interference Correction System (WICS) has been implemented for the ”NASA Langley National Transonic Facility. The correction capability is currently restricted to corrections for solid wall interference in the model pitch plane for Mach numbers, less than 0.45 due to a limitation in tunnel calibration data. A study to assess output sensitivity to the aerodynamic parameters of Reynolds number and Mach number was conducted on this code to further ensure quality during the correction process. In addition, this paper includes all investigation into possible correction due to a semispan test technique using a non metric standoff and all improvement to the standard data rejection algorithm.
Author
Wall Flow; Correction; Aerodynamic Interference

20010055248 NASA Langley Research Center, Hampton, VA USA
Reynolds Number Effects on Leading Edge Radius Variations of a Supersonic Transport at Transonic Conditions
Rivers, S. M. B., NASA Langley Research Center, USA; Wahls, R. A., NASA Langley Research Center, USA; Owens, L. R., NASA Langley Research Center, USA; [2001]; 27p; In English; 19th AIAA Applied Aerodynamics Conference, 11-14 Jun. 2001, Anaheim, CA, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Report No.(s): AIAA Paper 2001-2462; Copyright Waived; Avail: CASI; A03, Hardcopy; A01, Microfiche

A computational study focused on leading-edge radius effects and associated Reynolds number sensitivity for a High Speed Civil Transport configuration at transonic conditions was conducted as part of NASA’s High Speed Research Program. The primary purposes were to assess the capabilities of computational fluid dynamics to predict Reynolds number effects for a range of leading-edge radius distributions on a second-generation supersonic transport configuration, and to evaluate the potential performance benefits of each at the transonic cruise condition. Five leading-edge radius distributions are described, and the potential performance benefit including the Reynolds number sensitivity for each is presented. Computational results for two leading-edge radius distributions are compared with experimental results acquired in the National Transonic Facility over a broad Reynolds number range.
Author
Leading Edges; Radii; Reynolds Number; Wind Tunnel Tests; Computational Fluid Dynamics

20010055262 NASA Langley Research Center, Hampton, VA USA

On the Use of Surface Porosity to Reduce Unsteady Lift

Tinetti, Ana F., Virginia Polytechnic Inst. and State Univ., USA; Kelly, Jeffrey J., Virginia Polytechnic Inst. and State Univ., USA; Bauer, Steven X. S., NASA Langley Research Center, USA; Thomas, Russell H., NASA Langley Research Center, USA; [2001]; 14p; In English; 31st AIAA Fluid Dynamics Conference and Exhibit, 11-14 Jun. 2001, Anaheim, CA, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA; Original contains color illustrations

Report No.(s): AIAA Paper 2001-2921; Copyright Waived; Avail: CASI; A03, Hardcopy; A01, Microfiche

An innovative application of existing technology is proposed for attenuating the effects of transient phenomena, such as rotor-stator and rotor-strut interactions, linked to noise and fatigue failure in turbomachinery environments. A computational study was designed to assess the potential of passive porosity technology as a mechanism for alleviating interaction effects by reducing the unsteady lift developed on a stator airfoil subject to wake impingement. The study involved a typical high bypass fan Stator airfoil (solid baseline and several porous configurations), immersed in a free field and exposed to the effects of a transversely moving wake. It was found that, for the airfoil under consideration, the magnitude of the unsteady lift could be reduced more than 18% without incurring significant performance losses.

Author

Porosity; Airfoils; Computerized Simulation; Lift Augmentation

20010055431 NASA Langley Research Center, Hampton, VA USA

X-38 Experimental Aeroheating at Mach 10

Berry, Scott A., NASA Langley Research Center, USA; Horvath, Thomas J., NASA Langley Research Center, USA; Weilmuenster, K. James, NASA Langley Research Center, USA; Alter, Stephan J., NASA Langley Research Center, USA; Merski, N. Ronald, NASA Langley Research Center, USA; [2001]; 14p; In English; 35th AIAA Thermophysics Conference, 11-14 Jun. 2001, Anaheim, CA, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA; Original contains color illustrations

Report No.(s): AIAA Paper 2001-2828; Copyright Waived; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report provides an update of the hypersonic aerothermodynamic wind tunnel test program conducted at the NASA Langley Research Center in support of the X-38 program. Global surface heat transfer distributions were measured on 0.0177 and 0.0236 scale models of the proposed X-38 configuration at Mach 10 in air. The parametrics that were investigated primarily include freestream unit Reynolds numbers of 0.6 to 2.2 million per foot and body flap deflections of 15, 20, and 25 deg for an angle-of-attack of 40 deg. The model-scale variance was tested to obtain laminar, transitional, and turbulent heating levels on the defected bodyflaps. In addition, a limited investigation of forced boundary layer transition through the use of discrete roughness elements was performed. Comparisons of the present experimental results to computational predictions and previous experimental data were conducted Laminar, transitional, and turbulent heating levels were observed on the deflected body flap, which compared favorably to the computational results and to the predicted heating based on the flight aerothermodynamic database.

Author

Aerodynamic Heating; Aerothermodynamics; Wind Tunnel Tests; Heat Transfer; Temperature Distribution

20010055691 NASA Dryden Flight Research Center, Edwards, CA USA

Forebody Aerodynamics of the F-18 High Alpha Research Vehicle with Actuated Forebody Strakes

Fisher, David F., NASA Dryden Flight Research Center, USA; Murri, Daniel G., NASA Langley Research Center, USA; May 2001; 18p; Advanced Flow Management, 7-10 May 2001, Loen, Norway

Contract(s)/Grant(s): RTOP 710-55-04-E8-RR

Report No.(s): H-2447; MP-69-P-45; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Extensive pressure measurements and off-surface flow visualization were obtained on the forebody and strakes of the NASA F-18 High Alpha Research Vehicle (HARV) equipped with actuated forebody strakes. Forebody yawing moments were obtained by integrating the circumferential pressures on the forebody and strakes. Results show that large yawing moments can be generated with forebody strakes. At a 50 deg-angle-of-attack, deflecting one strake at a time resulted in a forebody yawing moment control reversal for small strake deflection angles. However, deflecting the strakes differentially about a 20 deg symmetric strake deployment eliminated the control reversal and produced a near linear variation of forebody yawing moment with differential strake deflection. At an angle of attack of 50 deg and for 0 deg and 20 deg symmetric strake deployments, a larger forebody yawing moment was generated by the forward fuselage (between the radome and the apex of the leading-edge extensions) than on the radome where the actuated forebody strakes were located. Cutouts on the flight vehicle strakes that were not on the wind tunnel

models are believed to be responsible for deficits in the suction peaks on the flight radome pressure distributions and differences in the forebody yawing moments.
Author
Forebodies; Strakes; Yawing Moments; Flow Visualization; Pressure Measurement

20010057623 National Advisory Committee for Aeronautics. Langley Aeronautical Lab., Langley Field, VA USA
Longitudinal Aerodynamic Characteristics and Effect of Rocket Jet on Drag of Models of the Hermes A-3A and A-3B Missiles in Free Flight at Mach Numbers From 0.6 to 2.0
Jackson, H. Herbert, National Advisory Committee for Aeronautics. Langley Aeronautical Lab., USA; Jun. 29, 1955; 44p; In English
Report No.(s): NACA-RM-SL55F15; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A free-flight investigation over a Mach number range from 0.6 to 2.0 has been conducted to determine the longitudinal aerodynamic characteristics and effect of rocket jet on zero-lift drag of 1/5-scale models of two ballistic-type missiles, the Hermes A-3A and A-3B. Models of both types of missiles exhibited very nearly linear normal forces and pitching moments over the angle-of-attack range of 8 deg to -4 deg and Mach number range tested. The centers of pressure for both missiles were not appreciably affected by Mach number over the subsonic range; however, between a Mach number of 1.02 and 1.50 the center of pressure for the A-3A model moved forward 0.34 caliber with increasing Mach number. At a trim angle-of-attack of approximately 30 deg, the A-3A model indicated a total drag coefficient 30% higher than the power-off zero-lift drag over the subsonic Mach number range and 10% higher over the supersonic range. Under the conditions of the present test, and excluding the effect of the jet on base drag, there was no indicated effect of the propulsive jet on the total drag of the A-3A model. The propulsive jet operating at a jet pressure ratio p(sub j)/p(sub o) of 0.8 caused approximately 100% increase in base drag over the Mach number range M = 0.6 to 1.0. This increase in base drag amounts to 15% of the total drag. An underexpanded jet operating at jet pressure ratios corresponding approximately to those of the full-scale missile caused a 22% reduction in base drag at M = 1.55 (p(sub j)/p(sub o) = 1.76) but indicated no change at M = 1.30 (p(sub j)/p(sub o) = 1.43). At M = 1.1 and p(sub j)/p(sub o) = 1.55, the jet caused a 50% increase in base drag.
Author
Aerodynamic Characteristics; Aerodynamic Drag; Drag Reduction; Ballistic Missiles; Flight Tests

20010059323 Naval Surface Warfare Center, Weapons Systems Dept., Dahlgren, VA USA
Improved Power-on, Base Drag Methodology for the Aeroprediction Code *Final Report*
Moore, Frank G., Aeroprediction, Inc., USA; Hymer, Thomas C., Naval Surface Warfare Center, USA; May 2001; 78p; In English
Report No.(s): NSWCDD/TR-00/67; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

Improved methods for base pressure prediction under base bleed and rocket motor-on conditions have been developed. The base bleed method makes several refinements to the method developed by Danberg at the Army Research Laboratory in Aberdeen, Maryland. The improved rocket motor-on, base pressure prediction improves upon the method developed at the Army Missile Command in Huntsville, Alabama by Brazzel and some of his colleagues. The major refinement to the base bleed method of Danberg was to estimate the power-off value of base pressure empirically based on an extensive data base, as opposed to using computational fluid dynamics codes to predict this term. The major modifications to the power-on base pressure prediction method of Brazzel was to extend its range of applicability to high values of thrust coefficient, to Mach numbers less than 1.5, and to different afterbody shapes. In comparing, the improved methods for power-on base drag, prediction to experiment, it was seen that both methods gave reasonable agreement to most experimental data bases. However, more validation is needed, particularly for the combined effects of angle of attack, fins, and power-on conditions.
Author
Aerodynamic Drag; Base Flow; Base Pressure; Data Bases; Prediction Analysis Techniques; Rocket Engines; Aerodynamics

20010059378 Naval Air Warfare Center, Aircraft Div., Patuxent River, MD USA
Effects of Various Shape Fillets on a 76/40 Double Delta Wing from Mach 0.18 to 0.7
Gonzalez, Hugo; Erickson, Gary; McLachlan, Blair; Bell, James; Jan. 1994; 39p; In English; Original contains color plates
Report No.(s): AD-A388748; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A 76 deg/4O deg sweep double delta wing was tested in the NASA Langley 1 x 10 ft HST from Mach 0.18 to 0.7 and from -4 deg to 42 deg angle of attack. The double delta wing strake/wing juncture was modified with three fillet shapes: linear, diamond,

and parabolic. The linear and diamond fillet size varied 0.5%, 1% and 2.5% (left and right fillet area / wing planform area). The parabolic fillet size varied 0.5% and 1% in size.
DTIC
Aerodynamic Characteristics; Delta Wings; Subsonic Speed; Wing Planforms

03
AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; aircraft ground operations; flight safety and hazards; and aircraft accidents. Systems and hardware specific to ground operations of aircraft and to airport construction are covered in 09 Research and Support Facilities (Air). Air traffic control is covered in 04 Aircraft Communications and Navigation. For related information see also 16 Space Transportation and Safety; and 85 Technology Utilization and Surface Transportation.

20010055666 Army Safety Center, Fort Rucker, AL USA
Flightfax; Army Aviation Risk-Management Information. April 2001, Volume 29, Number 4
Apr. 2001; 16p; In English
Report No.(s): AD-A388731; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Fiighffax is published by the U.S. Army Safety Center, Fort Rucker, AL 36362-5363. Information is for accident-prevention purposes only and is specifically prohibited for use for punitive purposes or matters of liability, litigation, or competition. This issue contains articles on hazards, spatial disorientation, army aviation, personnel awards, aviation accidents, and aviation safety.
DTIC
Accident Prevention; Aircraft Accidents; Aircraft Safety; Flight Safety

20010056522 Air Force Research Lab., Wright-Patterson AFB, OH USA
Ejection Seat Capabilities to Meet Agile Aircraft Requirements
Specker, Larry, Air Force Research Lab., USA; Plaga, John, Air Force Research Lab., USA; Santi, Vic, Aeronautical Systems Div., USA; Human Consequences of Agile Aircraft; May 2001, pp. 121-129; In English; See also 20010056513; Original contains color illustrations; Copyright Waived; Avail: CASI; A02, Hardcopy

Current US Air Force seats provide safe aircrew escape up to about 425 Knots Equivalent AirSpeed (KEAS). The performance limit of US ejection seats is cited as 600 KEAS, but very few successful ejections have occurred over 500 KEAS. Wind blast is a cause of major injuries and fatalities at airspeeds above 425 KEAS. Adverse aircraft altitude, attitude, and roll rates are also known to degrade survival probability. Advanced, highly-maneuverable aircraft are expected to make increasing demands on initial off-axis conditions with which ejection systems must contend. A notional representation of current aircraft sideslip capabilities.
Derived from text
Ejection; Survival; Ejection Seats; Highly Maneuverable Aircraft

20010056743 Lawrence Livermore National Lab., Livermore, CA USA
Ballistic Experiments with Titanium and Aluminum Targets *Final Report*
Gogolowski, Raymond P., Lawrence Livermore National Lab., USA; Morgan, Bruce R., Lawrence Livermore National Lab., USA; Apr. 2001; 30p; In English
Contract(s)/Grant(s): DTFA03-97-Z-900007
Report No.(s): PB2001-105073; No Copyright; Avail: CASI; A01, Microfiche; A03, Hardcopy

This report describes experiments in penetration mechanics on 6A1-4V titanium. This work was accomplished by the Lawrence Livermore National Laboratory (LLNL) at the LLNL Terminal Ballistics Laboratory of the Physics Directorate under an Interagency Agreement between the Federal Aviation Administration (FAA) William J. Hughes Technical Center and the Department of Energy (DOE). The work was accomplished under the FAA's Aircraft Catastrophic Failure Prevention Program as part of its research into the turbine engine uncontainment event. The object of the experiments was to determine the ballistic speed limit of 6A1-4V alloy titanium and 2024-T3 alloy aluminum and the failure modes of the projectiles and targets. Data was obtained for both materials using various thickness plates of the test materials to simulate aircraft skins and various size and shape 6A1-4V alloy titanium projectiles. The results of this experimental work will be used to help define the type of material failures

in material models of the DYNA3D finite element code, which are being developed/validated for evaluating aircraft/engine designs relative to the federal airworthiness standards and for improving mitigation/containment technology.
NTIS
Terminal Ballistics; Failure Analysis; Gas Turbine Engines; Aircraft Engines; Finite Element Method; Penetration; Projectiles; Targets; Titanium Alloys; Aluminum Alloys

20010056939 Civil Aeromedical Inst., Oklahoma City, OK USA
Pilot Visual Acquisition of Traffic: Operational Communications from OpEval-1 ***Final Report***
Prinzo, O. Veronika, Civil Aeromedical Inst., USA; May 2001; 20p; In English
Contract(s)/Grant(s): AM-B-00-HRR-516
Report No.(s): DOT/FAA/AM-01/9; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Avionics devices designed to provide pilots with graphically displayed traffic information will enable pilots to acquire and verify the identity of any intruder aircraft within the general area, either before or in accordance with a controller-issued traffic advisory or alert. A preliminary evaluation was performed of an airborne capability to display traffic information (OpEval-1, July 1999). As part of that evaluation, audiotapes were analyzed of the communications between pilots flying aircraft equipped with a cockpit display of traffic information (CDTI) and terminal radar approach controllers, who provided them with air traffic services. The results revealed that pilots and controllers participated more frequently in collaborative communications that resulted in a reduction in radio-frequency congestion and improved overall communications. Pilot persistence in scanning for traffic called by air traffic control (ATC), especially when that traffic was readily visible on the CDTI display, but not out the window, may have led to more responsive traffic reports, increases in positive visual acquisitions, and consequently proportionally fewer pilot reports of ”negative contact.” Only 4% of the pilots’ and controllers’ messages revealed communication problems such as inaccuracies, procedural deviations, and non-routine transactions. Information load, the novelty of pilot-initiated traffic calls, access to and knowledge of the traffic call sign by pilots, as well as the variability in ATC message structure each contributed to the occurrence of communication problems. The voice tape analyses suggest that new procedures and operational communications will be needed to support CDTI and guidance in collaborative decision-making involving air-ground traffic flow management. Whenever any new system, technology, capability, or application is evaluated prior to implementation in a well-defined environment such as the National Airspace System, the importance of pilot and controller communication training to overcome the interference effects of past experiences with ATC communication will need to be included as part of a comprehensive plan towards implementation.
Author
Pilot Training; Avionics; Display Devices; Airborne Equipment; Air Traffic Control

20010057787 NASA Langley Research Center, Hampton, VA USA
Evaluation of Test/Analysis Correlation Methods for Crash Applications
Lyle, Karen H., NASA Langley Research Center, USA; Bark, Lindley W., MSC.Software Corp., USA; Jackson, Karen E., Army Vehicle Technology Center, USA; [2001]; 13p; In English; American Helicopter Society 57th Annual Forum, 9-11 May 2001, Washington, DC, USA; Sponsored by American Helicopter Society, Inc., USA; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A project has been initiated to improve crash test and analysis correlation. The work in this paper concentrated on the test and simulation results for a fuselage section. Two drop tests of the section were conducted. The first test was designed to excite the linear structural response for comparison with finite element modal analysis results. The second test was designed to provide data for correlation with crash simulations. An MSC.Dytran model was developed to generate nonlinear transient dynamic results. Following minor modifications, the same model was executed in MSC.Nastran to generate modal analysis results. The results presented in this paper concentrate on evaluation of correlation methodologies for crash test data and finite element simulation results.
Author
Crashes; Data Simulation; Drop Tests; Fuselages

20010058911 General Accounting Office, Accounting and Information Management Div., Washington, DC USA
Air Traffic Control: Weak Computer Security Practices Jeopardize Flight Safety
May 1998; 26p; In English; Original contains color illustrations
Report No.(s): PB2001-104943; GAO/AIMD-98-155; No Copyright; Avail: CASI; A01, Microfiche; A03, Hardcopy

Security at our nations airports has received great attention in recent years due to several commercial aircraft explosions; however, securing our nations airports alone does not ensure safe air travel. It is also critical to secure the Federal Aviation

Administrations (FAA) air traffic control (ATC) computer systems that provide information to air traffic controllers and aircraft flight crews to ensure safe and expeditious movement of aircraft. Given the paramount importance of computer security of ATC systems, you asked us to determine (1) whether FAA is effectively managing physical security at ATC facilities and systems security for its current operational systems, (2) whether FAA is effectively managing systems security for future ATC modernization systems, and (3) the effectiveness of FAAs management structure and implementation of policy for computer security.
NTIS
Air Traffic Control; Computer Information Security; Flight Safety

20010058913 General Accounting Office, Resources, Community and Economic Development Div., Washington, DC USA
Air Traffic Control: Surveillance Radar Request for the Cherry Capital Airport
May 1998; 44p; In English; Original contains color illustrations
Report No.(s): PB2001-104950; GAO/RCED-98-118; B-278475; No Copyright; Avail: CASI; A01, Microfiche; A03, Hardcopy
This report discusses (1) FAAs decision-making process for installing surveillance radars at airports; (2) the factors, including costs, benefits, and air traffic projections, that FAA considered when conducting the 1994, 1996, and 1997 studies; (3) the impact, if any, that air traffic projections developed by other sources would have had on the results of the 1997 study; (4) actions FAA has taken to address safety concerns at the airport; and (5) FAAs plans to replace surveillance radars at airports with fewer total air traffic operations than the Cherry Capital Airport.
NTIS
Air Traffic Control; Surveillance Radar; Decision Making

04
AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes all modes of communication with and between aircraft; air navigation systems (satellite and ground based); and air traffic control. For related information see also 06 Avionics and Aircraft Instrumentation; 17 Space Communications; Spacecraft Communications, Command and Tracking, and 32 Communications and Radar.

20010059324 NASA Goddard Space Flight Center, Greenbelt, MD USA
GPS/Magnetometer Based Satellite Navigation and Attitude Determination
Deutschmann, Julie, NASA Goddard Space Flight Center, USA; Bar-Itzhack, Itzhack, Technion - Israel Inst. of Tech., Israel; Harman, Rick, NASA Goddard Space Flight Center, USA; [2001]; 3p; In English; Ion GPS 2001, 11-14 Sep. 2001, Salt Lake City, UT, USA; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche
In recent years algorithms were developed for orbit, attitude and angular-rate determination of Low Earth Orbiting (LEO) satellites. Those algorithms rely on measurements of magnetometers, which are standard, relatively inexpensive, sensors that are normally installed on every LEO satellite. Although magnetometers alone are sufficient for obtaining the desired information, the convergence of the algorithms to the correct values of the satellite orbital parameters, position, attitude and angular velocity is very slow. The addition of sun sensors reduces the convergence time considerably. However, for many LEO satellites the sun data is not available during portions of the orbit when the spacecraft (SC) is in the earth shadow. It is here where the GPS space vehicles (SV) can provide valuable support. This is clearly demonstrated in the present paper. Although GPS measurements alone can be used to obtain SC position, velocity, attitude and angular-rate, the use of magnetometers improve the results due to the synergistic effect of sensor fusion. Moreover, it is possible to obtain these results with less than three SVs. In this paper we introduce an estimation algorithm, which is a combination of an Extended Kalman Filter (EKF) and a Pseudo Linear Kalman Filter (PSELIKA).
Author
Global Positioning System; Magnetometers; Navigation Satellites; Attitude (Inclination)

05
AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes all stages of design of aircraft and aircraft structures and systems. Also includes aircraft testing, performance, and evaluation, and aircraft and flight simulation technology. For related information, see also 18 Spacecraft Design, Testing and Performance and 39 Structural Mechanics. For land transportation vehicles, see 85 Technology Utilization and Surface Transportation.

20010055264 NASA Dryden Flight Research Center, Edwards, CA USA
Comparison of X-31 Flight and Ground-Based Yawing Moment Asymmetries at High Angles of Attack
Cobleigh, Brent R., NASA Dryden Flight Research Center, USA; Croom, Mark A., NASA Langley Research Center, USA; May 2001; 18p; In English; Advanced Flow Management Symposium, 7-11 May 2001, Loen, Norway
Contract(s)/Grant(s): RTOP 710-55-24-E8-RR
Report No.(s): NASA/TM-2001-210393; H-2455; NAS 1.15:210393; Paper MP-69-P-42; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Significant yawing moment asymmetries were encountered during the high-angle-of-attack envelope expansion of the two X-31 aircraft. These asymmetries caused position saturations of the thrust-vectoring vanes and trailing-edge flaps during some stability-axis rolling maneuvers at high angles of attack. The two test aircraft had different asymmetry characteristics, and ship two has asymmetries that vary as a function of Reynolds number. Several aerodynamic modifications have been made to the X-31 forebody with the goal of minimizing the asymmetry. These modifications include adding transition strips on the forebody and noseboom, using two different length strakes, and increasing nose bluntness. Ultimately, a combination of forebody strakes, nose blunting, and noseboom transition strips reduced the yawing moment asymmetry enough to fully expand the high-angle-of-attack envelope. Analysis of the X-31 flight data is reviewed and compared to wind-tunnel and water-tunnel measurements. Several lessons learned are outlined regarding high-angle-of-attack configuration design and ground testing.
Author
Asymmetry; Water Tunnel Tests; Wind Tunnel Tests; Yawing Moments; Flight Envelopes; Forebodies

20010055695 NASA Langley Research Center, Hampton, VA USA
HSCT4.0 Application: Software Requirements Specification
Salas, A. O., NASA Langley Research Center, USA; Walsh, J. L., NASA Langley Research Center, USA; Mason, B. H., NASA Langley Research Center, USA; Weston, R. P., NASA Langley Research Center, USA; Townsend, J. C., NASA Langley Research Center, USA; Samareh, J. A., NASA Langley Research Center, USA; Green, L. L., NASA Langley Research Center, USA; May 2001; 78p; In English
Contract(s)/Grant(s): RTOP 725-10-11-01
Report No.(s): NASA/TM-2001-210867; NAS 1.15:210867; L-18072; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

The software requirements for the High Performance Computing and Communication Program High Speed Civil Transport application project, referred to as HSCT4.0, are described. The objective of the HSCT4.0 application project is to demonstrate the application of high-performance computing techniques to the problem of multidisciplinary design optimization of a supersonic transport configuration, using high-fidelity analysis simulations. Descriptions of the various functions (and the relationships among them) that make up the multidisciplinary application as well as the constraints on the software design arc provided. This document serves to establish an agreement between the suppliers and the customer as to what the HSCT4.0 application should do and provides to the software developers the information necessary to design and implement the system.
Author
Software Engineering; Design Optimization; Requirements; Applications Programs (Computers)

20010056304 NASA Dryden Flight Research Center, Edwards, CA USA
Flight Test Experience with an Electromechanical Actuator on the F-18 Systems Research Aircraft
Jensen, Stephen C., NASA Dryden Flight Research Center, USA; Jenney, Gavin D., Dynamic Controls, Inc., USA; Raymond, Bruce, Dynamic Controls, Inc., USA; Dawson, David, Wright Lab., USA; [2000]; 10p; In English; 19th AIAA Digital Avionics Systems Conference, 7-13 Oct. 2000, Philadelphia, PA, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Development of reliable power-by-wire actuation systems for both aeronautical and space applications has been sought recently to eliminate hydraulic systems from aircraft and spacecraft and thus improve safety, efficiency, reliability, and maintainability. The Electrically Powered Actuation Design (EPAD) program was a joint effort between the Air Force, Navy, and

NASA to develop and fly a series of actuators validating power-by-wire actuation technology on a primary flight control surface of a tactical aircraft. To achieve this goal, each of the EPAD actuators was installed in place of the standard hydraulic actuator on the left aileron of the NASA F/A-18B Systems Research Aircraft (SRA) and flown throughout the SRA flight envelope. Numerous parameters were recorded, and overall actuator performance was compared with the performance of the standard hydraulic actuator on the opposite wing. This paper discusses the integration and testing of the EPAD electromechanical actuator (EMA) on the SRA. The architecture of the EMA system is discussed, as well as its integration with the F/A-18 Flight Control System. The flight test program is described, and actuator performance is shown to be very close to that of the standard hydraulic actuator it replaced. Lessons learned during this program are presented and discussed, as well as suggestions for future research.
Author
Actuators; Flight Tests; Electromechanical Devices

20010056676 NASA, Washington, DC USA
The Eclipse Project
Tucker, Tom, NASA, USA; 2000; 178p; In English
Report No.(s): NASA/SP-2000-4523; NAS 1.21:4523; LC-00-067616; No Copyright; Avail: CASI; A09, Hardcopy; A02, Microfiche

The Eclipse Project by Tom Tucker provides a readable narrative and a number of documents that record an important flight research effort at NASA's Dryden Flight Research Center. Carried out by Kelly Space and Technology, Inc., in partnership with the Air Force and Dryden at Edwards Air Force Base in the Mojave Desert of California, this project tested and gathered data about a potential newer and less expensive way to launch satellites into space. Whether the new technology comes into actual use will depend on funding, market forces, and other factors at least partly beyond the control of the participants in the project. This is a familiar situation in the history of flight research.
Derived from text
Eclipse Project; Spacecraft Launching; Technology Utilization

20010057069 NASA Langley Research Center, Hampton, VA USA
MAVRIC Flutter Model Transonic Limit Cycle Oscillation Test
Edwards, John W., NASA Langley Research Center, USA; Schuster, David M., NASA Langley Research Center, USA; Spain, Charles V., NASA Langley Research Center, USA; Keller, Donald F., NASA Langley Research Center, USA; Moses, Robert W., NASA Langley Research Center, USA; May 2001; 20p; In English; 42nd AIAA/ASME/ASCE/AHS Structures, Structural Dynamics and Materials Conference, 16-19 Apr. 2001, Seattle, WA, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Contract(s)/Grant(s): RTOP 706-31-41-02
Report No.(s): NASA/TM-2001-210877; L-18082; NAS 1.15:210877; AIAA Paper 2001-1291; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The Models for Aeroelastic Validation Research Involving Computation semi-span wind-tunnel model (MAVRIC-I), a business jet wing-fuselage flutter model, was tested in NASA Langley's Transonic Dynamics Tunnel with the goal of obtaining experimental data suitable for Computational Aeroelasticity code validation at transonic separation onset conditions. This research model is notable for its inexpensive construction and instrumentation installation procedures. Unsteady pressures and wing responses were obtained for three wingtip configurations of clean, tipstore, and winglet. Traditional flutter boundaries were measured over the range of M = 0.6 to 0.9 and maps of Limit Cycle Oscillation (LCO) behavior were made in the range of M = 0.85 to 0.95. Effects of dynamic pressure and angle-of-attack were measured. Testing in both R134a heavy gas and air provided unique data on Reynolds number, transition effects, and the effect of speed of sound on LCO behavior. The data set provides excellent code validation test cases for the important class of flow conditions involving shock-induced transonic flow separation onset at low wing angles, including LCO behavior.
Author
Transonic Flow; Flutter; Wind Tunnel Models; Wing Tips; Wind Tunnel Tests

20010057593 Defence Science and Technology Organisation, Airframes and Engines Div., Melbourne, Australia
Literature Review on Aircraft Structural Risk and Reliability Analysis
Tong, Yu Chee, Defence Science and Technology Organisation, Australia; February 2001; 62p; In English
Report No.(s): DSTO-TR-1110; AR-011-772; Copyright; Avail: Issuing Activity

Aircraft structural risk and reliability analysis has gained considerable interest in the area of aircraft structural integrity and fleet management in recent times. In this report, a literature review of the current approaches and methodologies that have been

utilised in the area of structural risk and reliability analysis for aircraft structures and components is conducted. The structural risk and reliability approach discussed here deals mainly with the probability of failure due to aircraft structural fatigue. It reviews the engineering techniques and probabilistic methodologies that have been reported in the literature. It also discuss the advantages, disadvantage and the limitations of this approach and the reason for its need in aircraft structural and component integrity. The application of structural risk and reliability analysis is not limited to structural fatigue problem, its implication in areas other than airframe and component fatigue are also presented. This review shows that risk and reliability analysis can be a very useful tool for fleet management and it has potential implications for structural design.
Author
Structural Design; Reliability Analysis; Aircraft Structures; Airframes; Fatigue (Materials); Structural Failure

20010058883 NASA Langley Research Center, Hampton, VA USA
Hyper-X Stage Separation: Simulation Development and Results
Reubush, David E., NASA Langley Research Center, USA; Martin, John G., NASA Langley Research Center, USA; Robinson, Jeffrey S., NASA Langley Research Center, USA; Bose, David M., Analytical Mechanics Associates, Inc., USA; Strovers, Brian K., Analytical Mechanics Associates, Inc., USA; [2001]; 10p; In English; 10th AIAA/NAL-NASDA-ISAS International Space Planes and Hypersonic Systems and Technologies Conference Committee, 24-27 Apr. 2001, Kyoto, Japan; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Report No.(s): AIAA Paper 2001-1802; Copyright Waived; Avail: CASI; A02, Hardcopy; A01, Microfiche
This paper provides an overview of stage separation simulation development and results for NASA's Hyper-X program; a focused hypersonic technology effort designed to move hypersonic, airbreathing vehicle technology from the laboratory environment to the flight environment. This paper presents an account of the development of the current 14 degree of freedom stage separation simulation tool (SepSim) and results from use of the tool in a Monte Carlo analysis to evaluate the risk of failure for the separation event. Results from use of the tool show that there is only a very small risk of failure in the separation event.
Author
Simulation; Stage Separation; Hypersonic Vehicles

20010058885 NASA Langley Research Center, Hampton, VA USA
Coupled Aerodynamic and Structural Sensitivity Analysis of a High-Speed Civil Transport
Mason, B. H., NASA Langley Research Center, USA; Walsh, J. L., NASA Langley Research Center, USA; [2001]; 11p; In English; 42nd AIAA/ASME/ASCE/AHS/ASC Structure and Structural Dynamics Conference, 16-19 Apr. 2001, Seattle, WA, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Report No.(s): AIAA Paper 2001-1431; Copyright Waived; Avail: CASI; A03, Hardcopy; A01, Microfiche
An objective of the High Performance Computing and Communication Program at the NASA Langley Research Center is to demonstrate multidisciplinary shape and sizing optimization of a complete aerospace vehicle configuration by using high-fidelity, finite-element structural analysis and computational fluid dynamics aerodynamic analysis. In a previous study, a multi-disciplinary analysis system for a high-speed civil transport was formulated to integrate a set of existing discipline analysis codes, some of them computationally intensive, This paper is an extension of the previous study, in which the sensitivity analysis for the coupled aerodynamic and structural analysis problem is formulated and implemented. Uncoupled stress sensitivities computed with a constant load vector in a commercial finite element analysis code are compared to coupled aeroelastic sensitivities computed by finite differences. The computational expense of these sensitivity calculation methods is discussed.
Author
Aerodynamic Characteristics; Aeroelasticity; Aerospace Vehicles; Design Analysis; High Speed; Sensitivity Analysis

20010058924 NASA Langley Research Center, Hampton, VA USA
Hyper-X Mach 10 Engine Flowpath Development: Fifth Entry Test Conditions and Methodology
Bakos, R. J., General Applied Science Labs., Inc., USA; Tsai, C.-Y., General Applied Science Labs., Inc., USA; Rogers, R. C., NASA Langley Research Center, USA; Shih, A. T., NASA Langley Research Center, USA; [2001]; 9p; In English; 10th AIAA/NAL-NASDA-ISAS International Space Planes and Hypersonic Systems and Technologies Conference Committee, 24-27 Apr. 2001, Kyoto, Japan; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Report No.(s): AIAA Paper 2001-1814; Copyright Waived; Avail: CASI; A02, Hardcopy; A01, Microfiche
A series of Hyper-X Mach 10 flowpath ground tests are underway to obtain engine performance and operation data and to confirm and refine the flowpath design methods. The model used is a full-scale height, partial-width replica of the Hyper-X Research Vehicle propulsive flowpath with truncated forebody and aftbody. This is the fifth test entry for this model in the NASA-HYPULSE facility at GASL. For this entry the facility nozzle and model forebody were modified to better simulate the

engine inflow conditions at the target flight conditions. The forebody was modified to be a wide flat plate with no flow fences, the facility nozzle Mach number was increased, and the model was positioned to be tested in a semi-direct-connect arrangement. This paper presents a review of the test conditions, model calibrations, and a description of steady flow confirmation. The test series included runs using hydrogen fuel, and a silane-in-hydrogen fuel mixture. Other test parameters included the model mounting angle (relative to the tunnel flow), and the test gas oxygen fraction to account for the presence of [NO] in the test gas at the M10 conditions.
Author
Calibrating; Flight Conditions; Ground Tests; Hypersonic Speed; Mach Number; Proving; Research Vehicles

20010058927 George Washington Univ., Joint Inst. for Advancement of Flight Sciences, Hampton, VA USA
Impact Test and Simulation of Energy Absorbing Concepts for Earth Entry Vehicles
Billings, Marcus D., George Washington Univ., USA; Fasanella, Edwin L., Army Research Lab., USA; Kellas, Sotiris, Veridian Systems, Inc., USA; [2001]; 11p; In English; 42nd AIAA/ASME/ASCE/AHS/ASC Structure and Structural Dynamics Conference, 16-19 Apr. 2001, Seattle, WA, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Contract(s)/Grant(s): NCC1-331
Report No.(s): AIAA Paper 2001-1602; Copyright Waived; Avail: CASI; A03, Hardcopy; A01, Microfiche

Nonlinear dynamic finite element simulations have been performed to aid in the design of an energy absorbing concept for a highly reliable passive Earth Entry Vehicle (EEV) that will directly impact the Earth without a parachute. EEV's are designed to return materials from asteroids, comets, or planets for laboratory analysis on Earth. The EEV concept uses an energy absorbing cellular structure designed to contain and limit the acceleration of space exploration samples during Earth impact. The spherical shaped cellular structure is composed of solid hexagonal and pentagonal foam-filled cells with hybrid graphite- epoxy/Kevlar cell walls. Space samples fit inside a smaller sphere at the center of the EEV's cellular structure. Comparisons of analytical predictions using MSC,Dytran with test results obtained from impact tests performed at NASA Langley Research Center were made for three impact velocities ranging from 32 to 40 m/s. Acceleration and deformation results compared well with the test results. These finite element models will be useful for parametric studies of off-nominal impact conditions.
Author
Impact Tests; Simulation; Energy Absorption; Kevlar (Trademark); Impact Velocity; Atmospheric Entry; Aerospace Vehicles

20010059026 NASA Langley Research Center, Hampton, VA USA
An Earth Entry Vehicle For Returning Samples From Mars
Mitcheltree, R., NASA Langley Research Center, USA; Hughes, S., NASA Langley Research Center, USA; Dillman, R., NASA Langley Research Center, USA; Teter, J., NASA Langley Research Center, USA; [2001]; 10p; In English; 2nd International Symposium on Atmospheric Reentry Vehicles and Systems, 26-29 Mar. 2001, Arcachon, France; Sponsored by Association Aeronautique et Astronautique de France, France
Report No.(s): AAAF Paper ARVS-102; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The driving requirement for design of a Mars Sample return mission is assuring containment of the returned samples. The impact of this requirement on developmental costs, mass allocation, and design approach of the Earth Entry Vehicle is significant. A simple Earth entry vehicle is described which can meet these requirements and safely transport the Mars Sample Return mission's sample through the Earth's atmosphere to a recoverable location on the surface. Detailed analysis and test are combined with probabilistic risk assessment to design this entirely passive concept that circumvents the potential failure modes of a parachute terminal descent system. The design also possesses features that mitigate other risks during the entry, descent, landing and recovery phases. The results of a full-scale drop test are summarized.
Author
Atmospheric Entry; Earth Atmosphere; Full Scale Tests; Mars Sample Return Missions

20010059179 NASA Langley Research Center, Hampton, VA USA
Optimal Design of Grid-Stiffened Panels and Shells With Variable Curvature
Ambur, Damodar R., NASA Langley Research Center, USA; Jaunky, Navin, Eagle Aeronautics, Inc., USA; Composite Structures; 2001; ISSN 0263-8223; Volume 52, pp. 173-180; In English; Copyright; Avail: Issuing Activity

A design strategy for optimal design of composite grid-stiffened structures with variable curvature subjected to global and local buckling constraints is developed using a discrete optimizer. An improved smeared stiffener theory is used for the global buckling analysis. Local buckling of skin segments is assessed using a Rayleigh-Ritz method that accounts for material anisotropy and transverse shear flexibility. The local buckling of stiffener segments is also assessed. Design variables are the axial and transverse stiffener spacing, stiffener height and thickness, skin laminate, and stiffening configuration. Stiffening configuration

is herein defined as a design variable that indicates the combination of axial, transverse and diagonal stiffeners in the stiffened panel. The design optimization process is adapted to identify the lightest-weight stiffening configuration and stiffener spacing for grid-stiffened composite panels given the overall panel dimensions. in-plane design loads, material properties. and boundary conditions of the grid-stiffened panel or shell.
Author
Design Optimization; Boundary Conditions; Composite Structures; Curvature; Design Analysis; Panels

06
AVIONICS AND AIRCRAFT INSTRUMENTATION

Includes all stages of design of aircraft and aircraft structures and systems. Also includes aircraft testing, performance, and evaluation, and aircraft and flight simulation technology. For related information, see also 18 Spacecraft Design, Testing and Performance and 39 Structural Mechanics. For land transportation vehicles, see 85 Technology Utilization and Surface Transportation.

20010055268 NASA Pasadena Office, CA USA
Apparatus and Method for Measuring Air Temperature Ahead of an Aircraft for Controlling a Variable Inlet/Engine Assembly
Gary, Bruce L., Inventor, Jet Propulsion Lab., California Inst. of Tech., USA; Apr. 03, 2001; 16p; In English
Patent Info.: NASA-Case-NPO-19742-1-CU; US-Patent-6,209,821; US-Patent-Appl-SN-408648; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The apparatus and method employ remote sensing to measure the air temperature a sufficient distance ahead of the aircraft to allow time for a variable inlet/engine assembly to be reconfigured in response to the measured temperature, to avoid inlet unstart and/or engine compressor stall. In one embodiment, the apparatus of the invention has a remote sensor for measuring at least one air temperature ahead of the vehicle and an inlet control system for varying the inlet. The remote sensor determines a change in temperature value using at least one temperature measurement and prior temperature measurements corresponding to the location of the aircraft. The control system uses the change in air temperature value to vary the inlet configuration to maintain the position of the shock wave during the arrival of the measured air in the inlet. In one embodiment, the method of the invention includes measuring at least one air temperature ahead of the vehicle, determining an air temperature at the vehicle from prior air temperature measurements, determining a change in temperature value using the air temperature at the vehicle and the at least one air temperature measurement ahead of the vehicle, and using the change in temperature value to-reposition the airflow inlet, to cause the shock wave to maintain substantially the same position within the inlet as the airflow temperature changes within the inlet.
Official Gazette of the U.S. Patent and Trademark Office
Temperature Measurement; Remote Sensing; Intake Systems

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.

20010056686 NASA Glenn Research Center, Cleveland, OH USA
Supersonic Wind Tunnel Tests of a Half-Axisymmetric 12 deg-Spike Inlet to a Rocket-Based Combined-Cycle Propulsion System
DeBonis, J. R., NASA Glenn Research Center, USA; Trefny, C. J., NASA Glenn Research Center, USA; February 2001; 22p; In English; 37th Combustion Subcommittee, 25th Airbreathing Propulsion Subcommittee and 19th Propulsion Systems Hazards Subcommi8ttee Joint Meeting, 13-17 Nov. 2000, Monterey, CA, USA; Sponsored by Joint Army-Navy-Air Force Interagency Propulsion Committee, USA
Contract(s)/Grant(s): RTOP 523-61-33
Report No.(s): NASA/TM-2001-210567; E-12533; NAS 1.15:210567; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Results of an isolated inlet test for NASA's GTX air-breathing launch vehicle concept are presented. The GTX is a Vertical Take-off/ Horizontal Landing reusable single-stage-to-orbit system powered by a rocket-based combined-cycle propulsion

system. Tests were conducted in the NASA Glenn 1- by 1-Foot Supersonic Wind Tunnel during two entries in October 1998 and February 1999. Tests were run from Mach 2.8 to 6. Integrated performance parameters and static pressure distributions are reported. The maximum contraction ratios achieved in the tests were lower than predicted by axisymmetric Reynolds-averaged Navier-Stokes computational fluid dynamics (CFD). At Mach 6, the maximum contraction ratio was roughly one-half of the CFD value of 16. The addition of either boundary-layer trip strips or vortex generators had a negligible effect on the maximum contraction ratio. A shock boundary-layer interaction was also evident on the end-walls that terminate the annular flowpath cross section. Cut-back end-walls, designed to reduce the boundary-layer growth upstream of the shock and minimize the interaction, also had negligible effect on the maximum contraction ratio. Both the excessive turning of low-momentum comer flows and local over-contraction due to asymmetric end-walls were identified as possible reasons for the discrepancy between the CFD predictions and the experiment. It is recommended that the centerbody spike and throat angles be reduced in order to lessen the induced pressure rise. The addition of a step on the cowl surface, and planar end-walls more closely approximating a plane of symmetry are also recommended. Provisions for end-wall boundary-layer bleed should be incorporated.
Author
Air Breathing Boosters; Hypersonic Speed; Computational Fluid Dynamics; Wind Tunnel Tests; Propulsion; Pressure Distribution

20010059235 Los Alamos National Lab., NM USA
Proportion of Plastic Work Converted to Heat in T16Al4V: MTS Model Prediction and Experimental Data
Macdougall, D. A. S.; Maudlin, P. J.; 2001; 14p; In English
Report No.(s): PB2001-105675; LA-UR-00-2880; No Copyright; Avail: National Technical Information Service (NTIS)
The conversion rate of plastic work to heat, F, is an important quantity. It is necessary in finite element simulations involving plasticity in which temperature calculations are made. In this paper, the Mechanical Threshold Stress (MTS) model is compared to experimental measurements of the variation of with plastic strain for Ti-6Al-4V. The experiment was performed in high-speed torsion with the surface temperature measured using radiometry.
NTIS
Plastic Properties; Stress Analysis

20010059582 NASA Langley Research Center, Hampton, VA USA
Transonic Investigation of Two-Dimensional Nozzles Designed for Supersonic Cruise
Capone, Francis J., NASA Langley Research Center, USA; Deere, Karen A., NASA Langley Research Center, USA; [2001]; 26p; In English; 37th AIAA/ASME/SAE/ASEE Joint Propulsion Conference and Exhibit, 8-11 Jul. 2001, Salt Lake City, UT, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Report No.(s): AIAA Paper 2001-3199; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
An experimental and computational investigation has been conducted to determine the off-design uninstalled drag characteristics a of a two-dimensional convergent-divergent nozzle designed for a supersonic cruise civil transport. The main objective of this investigation was to determine the effects of varying nozzle external flap curvature and sidewall boattail angle and curvature on nozzle drag The experimental investigation was conducted in the Langley 16-Foot Transonic Tunnel at Mach numbers from 0.80 to 1.20 at nozzle pressure ratios up to nine. Three-dimensional simulations of nozzle performance were obtained with the computational fluid dynamics code PAB using turbulence closure and nonlinear Reynolds stress modeling. The results of this investigation indicate that excellent correlation between experimental and predicted results was obtained for the nozzle with a moderate amount of boattail curvature. The nozzle with an external flap having a sharp shoulder (no curvature) had the lowest nozzle pressure drag. At a Mach number of 1.2, sidewall pressure drag doubled as sidewall boattail angle was increased from 4 to 8 deg. Reducing the height of the sidewall caused large decreases in both the sidewall and flap pressure drags.
Author
Convergent-Divergent Nozzles; Computational Fluid Dynamics; Curvature; Three Dimensional Models; Transonic Wind Tunnels; Drag

20010059609 NASA Glenn Research Center, Cleveland, OH USA

Infrared Low-Temperature Turbine Vane Rough Surface Heat Transfer Measurements

Boyle, R. J., NASA Glenn Research Center, USA; Spuckler, C. M., NASA Glenn Research Center, USA; Lucci, B. L., NASA Glenn Research Center, USA; Camperchioli, W. P., NASA Glenn Research Center, USA; Journal of Turbomachinery; January 2001; Volume 123, pp. 168-177; In English; 45th International Gas Turbine and Aeroengine Congress and Exhibition, 8-11 Mar. 2000, Munich, Germany; Previously cited as 20000082017

Report No.(s): Paper-2000-GT-216; Copyright; Avail: Issuing Activity

Turbine vane heat transfer distributions obtained using an infrared camera technique are described. Infrared thermography was used because noncontact surface temperature measurements were desired. Surface temperatures were 80 C or less. Tests were conducted in a three-vane linear cascade, with inlet pressures between 0.14 and 1.02 atm, and exit Mach numbers of 0.3, 0.7, and 0.9, for turbulence intensities of approximately 1 and 10 percent. Measurements were taken on the vane suction side, and on the pressure side leading edge region. The designs for both the vane and test facility are discussed. The approach used to account for conduction within the vane is described. Midspan heat transfer distributions are given for the range of test conditions.

Author

Heat Transfer; Temperature Measurement; Infrared Radiation; Turbines; Vanes; Surface Temperature

08
AIRCRAFT STABILITY AND CONTROL

Includes flight dynamics, aircraft handling qualities; piloting; flight controls; and autopilots. For related information, see also 05 Aircraft Design, Testing and Performance and 06 Avionics and Aircraft Instrumentation.

20010054946 NASA Dryden Flight Research Center, Edwards, CA USA

On-Line Mu Method for Robust Flutter Prediction in Expanding a Safe Flight Envelope for an Aircraft Model Under Flight Test

Lind, Richard C., Inventor, NASA Dryden Flight Research Center, USA; Brenner, Martin J., NASA Dryden Flight Research Center, USA; Apr. 10, 2001; 36p; In English

Patent Info.: Filed 6 May 1998; NASA-Case-DRC-09800-1; US-Patent-6,216,063; US-Patent-Appl-SN-074024; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A structured singular value (mu) analysis method of computing flutter margins has robust stability of a linear aeroelastic model with uncertainty operators (Delta). Flight data is used to update the uncertainty operators to accurately account for errors in the computed model and the observed range of aircraft dynamics of the aircraft under test caused by time-varying aircraft parameters, nonlinearities, and flight anomalies, such as test nonrepeatability. This mu-based approach computes predict flutter margins that are worst case with respect to the modeling uncertainty for use in determining when the aircraft is approaching a flutter condition and defining an expanded safe flight envelope for the aircraft that is accepted with more confidence than traditional methods that do not update the analysis algorithm with flight data by introducing mu as a flutter margin parameter that presents several advantages over tracking damping trends as a measure of a tendency to instability from available flight data.

Official Gazette of the U.S. Patent and Trademark Office

Flutter Analysis; Flight Envelopes; Prediction Analysis Techniques

20010056315 Institute for Software Research, Inc., Fairmont, WV USA

Online Learning Flight Control for Intelligent Flight Control Systems (IFCS) ***Final Report, 3 Feb. 2000 - 16 Mar. 2001***

Niewoehner, Kevin R., Institute for Software Research, Inc., USA; [2001]; 5p; In English

Contract(s)/Grant(s): NCC4-125; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

The research accomplishments for the cooperative agreement 'Online Learning Flight Control for Intelligent Flight Control Systems (IFCS)' include the following: (1) previous IFC program data collection and analysis; (2) IFC program support site (configured IFC systems support network, configured Tornado/VxWorks OS development system, made Configuration and Documentation Management Systems Internet accessible); (3) Airborne Research Test Systems (ARTS) II Hardware (developed hardware requirements specification, developing environmental testing requirements, hardware design, and hardware design development); (4) ARTS II software development laboratory unit (procurement of lab style hardware, configured lab style hardware, and designed interface module equivalent to ARTS II faceplate); (5) program support documentation (developed software development plan, configuration management plan, and software verification and validation plan); (6) LWR algorithm analysis (performed timing and profiling on algorithm); (7) pre-trained neural network analysis; (8) Dynamic Cell Structures

(DCS) Neural Network Analysis (performing timing and profiling on algorithm); and (9) conducted technical interchange and quarterly meetings to define IFC research goals.
Derived from text
Algorithms; Computer Programming; Configuration Management; Specifications

20010057781 NASA Langley Research Center, Hampton, VA USA
A Wind-Tunnel Parametric Investigation of Tiltrotor Whirl-Flutter Stability Boundaries
Piatak, David J., NASA Langley Research Center, USA; Kvaternik, Raymond G., NASA Langley Research Center, USA; Nixon, Mark W., Army Research Lab., USA; Langston, Chester W., Army Research Lab., USA; Singleton, Jeffrey D., Army Research Lab., USA; Bennett, Richard L., Textron Bell Helicopter, USA; Brown, Ross K., Textron Bell Helicopter, USA; [2001]; 13p; In English; America Helicopter Society 57th Annual Forum, 9-11 May 2001, Washington, DC, USA; Sponsored by American Helicopter Society, Inc., USA; Copyright Waived; Avail: CASI; A03, Hardcopy; A01, Microfiche

A wind-tunnel investigation of tiltrotor whirl-flutter stability boundaries has been conducted on a 1/5-size semispan tiltrotor model known as the Wing and Rotor Aeroelastic Test System (WRATS) in the NASA-Langley Transonic Dynamics Tunnel as part of a joint NASA/Army/Bell Helicopter Textron, Inc. (BHTI) research program. The model was first developed by BHTI as part of the JVX (V-22) research and development program in the 1980's and was recently modified to incorporate a hydraulically-actuated swashplate control system for use in active controls research. The modifications have changed the model's pylon mass properties sufficiently to warrant testing to re-establish its baseline stability boundaries. A parametric investigation of the effect of rotor design variables on stability was also conducted. The model was tested in both the on-downstop and off-downstop configurations, at cruise flight and hover rotor rotational speeds, and in both air and heavy gas (R-134a) test mediums. Heavy gas testing was conducted to quantify Mach number compressibility effects on tiltrotor stability. Experimental baseline stability boundaries in air are presented with comparisons to results from parametric variations of rotor pitch-flap coupling and control system stiffness. Increasing the rotor pitch-flap coupling (delta(sub 3) more negative) was found to have a destabilizing effect on stability, while a reduction in control system stiffness was found to have little effect on whirl-flutter stability. Results indicate that testing in R-134a, and thus matching full-scale tip Mach number, has a destabilizing effect, which demonstrates that whirl-flutter stability boundaries in air are unconservative.
Author
Flutter; Rotor Aerodynamics; Rotors; Stability; Wind Tunnel Tests

20010059025 NASA Langley Research Center, Hampton, VA USA
An Experimental Evaluation of Generalized Predictive Control for Tiltrotor Aeroelastic Stability Augmentation in Airplane Mode of Flight
Kvaternik, Raymond G., NASA Langley Research Center, USA; Piatak, David J., NASA Langley Research Center, USA; Nixon, Mark W., Army Research Lab., USA; Langston, Chester W., Army Research Lab., USA; Singleton, Jeffrey D., Army Research Lab., USA; Bennett, Richard L., Textron Bell Helicopter, USA; Brown, Ross K., Textron Bell Helicopter, USA; [2001]; 15p; In English; American Helicopter Society 57th Annual Forum, 9-11 May 2001, Washington, DC, USA; Sponsored by American Helicopter Society, Inc., USA; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The results of a joint NASA/Army/Bell Helicopter Textron wind-tunnel test to assess the potential of Generalized Predictive Control (GPC) for actively controlling the swashplate of tiltrotor aircraft to enhance aeroelastic stability in the airplane mode of flight are presented. GPC is an adaptive time-domain predictive control method that uses a linear difference equation to describe the input-output relationship of the system and to design the controller. The test was conducted in the Langley Transonic Dynamics Tunnel using an unpowered 1/5-scale semispan aeroelastic model of the V-22 that was modified to incorporate a GPC-based multi-input multi-output control algorithm to individually control each of the three swashplate actuators. Wing responses were used for feedback. The GPC-based control system was highly effective in increasing the stability of the critical wing mode for all of the conditions tested, without measurable degradation of the damping in the other modes. The algorithm was also robust with respect to its performance in adjusting to rapid changes in both the rotor speed and the tunnel airspeed.
Author
Tilt Rotor Aircraft; Adaptive Control; Stability Augmentation; Predictions; Aeroelasticity; Control Stability; Helicopters

09
RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, runways, hangars, and aircraft repair and overhaul facilities; wind tunnels, water tunnels, and shock tubes; flight simulators; and aircraft engine test stands. Also includes airport ground equipment and systems. For airport ground operations see 03 Air Transportation and Safety. For astronautical facilities see 14 Ground Support Systems and Facilities (Space).

20010056521 Air Force Research Lab., Wright-Patterson AFB, OH USA
Simulation
Albery, W., Air Force Research Lab., USA; Human Consequences of Agile Aircraft; May 2001, pp. 111-120; In English; See also 20010056513; Original contains color illustrations; Copyright Waived; Avail: CASI; A02, Hardcopy

Supermaneuverable flight is characterized by high angle-of-attack flight and motion in the longitudinal, or x (chest-to-back), lateral y (side-to-side), and vertical, or z (head-to-toe) axes. These three aircraft axes are shown. The high agility flight environment is also characterized by slightly lower +Gz levels, shorter +Gz durations, very high G onset rates, high angular rates, and multiple axis G stress as compared to the conventional fighter environment. Only a few jet aircraft are currently capable of this type of flight. Those aircraft that are equipped with thrust-vectoring jet engines (Su-27, Su-37, Harrier, X-31, F-22) are capable of directing thrust in a direction other than along the longitudinal axis of the aircraft. by directing the thrust up and down, the aircraft becomes agile in the pitch axis. The F-22 has pitch axis thrust-vectoring. When the thrust is directed laterally, an aircraft has the capability to yaw while traversing along a longitudinal velocity vector. The X-31 has both pitch and yaw axis thrust vectoring. Maximum G levels, angular velocities, and angular accelerations of supermaneuverable aircraft are shown.
Author
Flight Simulation; Flight Conditions; Thrust Vector Control

20010059240 NASA Glenn Research Center, Cleveland, OH USA
Development of Dynamic Flow Field Pressure Probes Suitable for Use in Large Scale Supersonic Wind Tunnels
Porro, A. Robert, NASA Glenn Research Center, USA; [2000]; 17p; In English; 94th Meeting, Supersonic Tunnel Association, International (STAI), 10-12 Sep. 2000, Stockholm, Sweden; Sponsored by Aeronautical Research Inst. of Sweden, Sweden
Contract(s)/Grant(s): RTOP 523-90-43; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A series of dynamic flow field pressure probes were developed for use in large-scale supersonic wind tunnels at NASA Glenn Research Center. These flow field probes include pitot, static, and five-hole conical pressure probes that are capable of capturing fast acting flow field pressure transients that occur on a millisecond time scale. The pitot and static probes can be used to determine local Mach number time histories during a transient event. The five-hole conical pressure probes are used primarily to determine local flow angularity, but can also determine local Mach number. These probes were designed, developed, and tested at the NASA Glenn Research Center. They were also used in a NASA Glenn 10-by 10-Foot Supersonic Wind Tunnel (SWT) test program where they successfully acquired flow field pressure data in the vicinity of a propulsion system during an engine compressor staff and inlet unstart transient event. Details of the design, development, and subsequent use of these probes are discussed in this report.
Author
Flow Distribution; Dynamic Pressure; Supersonic Wind Tunnels; Wind Tunnel Tests; Pressure Sensors

20010059583 NASA Langley Research Center, Hampton, VA USA
Hypervelocity Capability of the HYPULSE Shock-Expansion Tunnel for Scramjet Testing
Foelsche, Robert O., General Applied Science Labs., Inc., USA; Rogers, R. Clayton, NASA Langley Research Center, USA; Tsai, Ching-Yi, General Applied Science Labs., Inc., USA; Bakos, Robert J., General Applied Science Labs., Inc., USA; Shih, Ann T., NASA Langley Research Center, USA; [2001]; 10p; In English; 23rd International Symposium on Shock Waves, 22-27 Jul. 2001, Fort Worth, TX, USA
Report No.(s): ISSW23 Paper-1047; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

New hypervelocity capabilities for scramjet testing have recently been demonstrated in the HYPULSE Shock-Expansion Tunnel (SET). With NASA's continuing interests in scramjet testing at hypervelocity conditions (Mach 12 and above), a SET nozzle was designed and added to the HYPULSE facility. Results of tests conducted to establish SET operational conditions and facility nozzle calibration are presented and discussed for a Mach 15 (M15) flight enthalpy. The measurements and detailed computational fluid dynamics calculations (CFD) show the nozzle delivers a test gas with sufficiently wide core size to be suitable for free-jet testing of scramjet engine models of similar scale as, those tested in conventional low Mach number blow-down test facilities.
Author
Supersonic Combustion Ramjet Engines; Shock Tunnels; Computational Fluid Dynamics; Free Jets

20010059867 Defence Science and Technology Organisation, Air Operations Div., Fishermans Bend, Australia
COMFRC: Data Acquisition Software for the AMRL Low Speed Wind Tunnel
Edwards Craig D., Defence Science and Technology Organisation, Australia; Lam, Stephen S., Defence Science and Technology Organisation, Australia; Link, Yoel Y., Defence Science and Technology Organisation, Australia; April 2001; 56p; In English; Original contains color illustrations
Report No.(s): DSTO-TN-0347; DODA-AR-011-829; Copyright; Avail: Issuing Activity

The data acquisition system in the Low Speed Wind Tunnel (LSWT) at the Aeronautical and Maritime Research Laboratory (AMRL) was upgraded recently. A new UNIX based host computer provides a C and X/Motif software development environment. COMFRC is the primary software responsible for the data acquisition, data reduction and storage of data in the LSWT. The operator can follow a test schedule and take data accordingly from a single graphical user interface. Data and results are displayed in real time during the acquisition process. This document provides details of the new data acquisition system and its operation. The procedures required to configure and carry out an entire wind tunnel test using COMFRC and a suite of associated software packages are described in detail.
Author
Applications Programs (Computers); Data Acquisition; Low Speed Wind Tunnels; Real Time Operation; Software Engineering; UNIX (Operating System); Data Storage

12
ASTRONAUTICS (GENERAL)

Includes general research topics related to space flight and manned and unmanned space vehicles, platforms or objects launched into, or assembled in, outer space; and related components and equipment. Also includes manufacturing and maintenance of such vehicles or platforms. For specific topics in astronautics see categories 13 through 20. For extraterrestrial exploration, see 91 Lunar and Planetary Science and Exploration.

20010055680 Army War Coll., Carlisle Barracks, PA USA
Global Change: The Air Force's Successful Transformation to the Expeditionary Aerospace Force
Konicki, Kennth M.; Jan. 2001; 29p; In English
Report No.(s): AD-A389038; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

In an era of globalization, shrinking defense dollars and costly weapon systems, the services and defense agencies must increasingly transform into more cost-effective, versatile or lethal organizations. Unfortunately, most organizational transformation efforts are unproductive and abandoned before any appreciable change occurs. Against this pessimistic backdrop, the Air Force's successful transformation to the Expeditionary Aerospace Force (EAF) warrants examination. This study analyzes the EAF development process to distill seven factors that help explain why the transformation succeeded. It discusses the defense environment that. pressed for change, the EAF visioning process, the role played by senior Air Force leaders, the influence of organizational culture, and the way EAF was permanently embedded in the service. by focusing on the success factors, the study offers the EAF transformation as a potential template to manage future organizational change.
DTIC
Organizations; Aerospace Systems; Armed Forces (USA)

20010056601 NASA, Washington, DC USA
Aerospace Safety Advisory Panel *Annual Report, 1998*
February 1999; 94p; In English; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

This report covers the activities of the Aerospace Safety Advisory Panel (ASAP) for calendar year 1998-a year of sharp contrasts and significant successes at NASA. The year opened with the announcement of large workforce cutbacks. The slip in the schedule for launching the International Space Station (ISS) created a five-month hiatus in Space Shuttle launches. This slack period ended with the successful and highly publicized launch of the STS-95 mission. As the year closed, ISS assembly began with the successful orbiting and joining of the Functional Cargo Block (FGB), Zarya, from Russia and the Unity Node from the USA. Throughout the year, the Panel maintained its scrutiny of NASA's safety processes. of particular interest were the potential effects on safety of workforce reductions and the continued transition of functions to the Space Flight Operations Contractor. Attention was also given to the risk management plans of the Aero-Space Technology programs, including the X-33, X-34, and X-38. Overall, the Panel concluded that safety is well served for the present. The picture is not as clear for the future. Cutbacks have limited the depth of talent available. In many cases, technical specialties are 'one deep.' The extended hiring freeze has resulted in an older workforce that will inevitably suffer significant departures from retirements in the near future. The resulting

’brain drain’ could represent a future safety risk unless appropriate succession planning is started expeditiously. This and other topics are covered in the section addressing workforce. The major NASA programs are also limited in their ability to plan property for the future. This is of particular concern for the Space Shuttle and ISS because these programs are scheduled to operate well into the next century. In the case of the Space Shuttle, beneficial and mandatory safety and operational upgrades are being delayed because of a lack of sufficient present funding. Likewise, the ISS has little flexibility to begin long lead-time items for upgrades or contingency planning. For example, the section on computer hardware and software contains specific findings related to required longer range safety-related actions. NASA can be proud of its accomplishments this past year, but must remain ever vigilant, particularly as ISS assembly begins to accelerate. The Panel will continue to focus on both the short- and long-term aspects of risk management and safety planning. This task continues to be made manageable and productive by the excellent cooperation the Panel receives from both NASA and its contractors. Particular emphasis will continue to be directed to longer term workforce and program planning issues as well as the immediate risks associated with ISS assembly and the initial flights of the X-33 and X-34. Section 2 of this report presents specific findings and recommendations generated by ASAP activities during 1998. Section 3 contains more detailed information in support of these findings and recommendations. Appendix A is a current roster of Panel members, consultants, and staff. Appendix B contains NASA’s response to the findings and recommendations from the 1997 ASAP Annual Report. Appendix C details the fact-finding activities of the Panel in 1998. During the year, Mr. Richard D. Blomberg was elected chair of the Panel and Vice Admiral (VADM) Robert F Dunn was elected deputy chair. VADM Bernard M. Kauderer moved from consultant to member. Mr. Charles J. Donlan retired from the Panel after many years of meritorious service. Ms. Shirley C. McCarty and Mr. Robert L. (’Hoot’) Gibson joined the Panel as consultants.
Author
Aerospace Safety; Management Planning; Risk; Space Shuttles; Mission Planning

20010056688 NASA, USA
Inter-Agency Consultative Group for Space Science (IACG): Handbook of Missions and Payloads
May 1994; 130p; In English; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

The ACE spacecraft design is based on the Charge Composition Explorer (CCE) built by Johns Hopkins University (JHU) and the Applied Physics Lab (APL) for the AMPTE program. ACE is designed as a spinning spacecraft with its spin axis aligned to the Earth-Sun axis. The ACE launch weight will be approx. 633 kg, including 105 kg of scientific instruments and 184 kg of propellant. Using a Delta-class expendable launch vehicle, ACE will be launched into an L1 libration point (240 R(sub e)) orbit. Telemetry will be 6.7 kbps average, using tape recorder storage with daily readout to DSN. The experiment power requirement is approximately 76 W nominal and 96 W peak. The prime objective of the ACE mission is: (1) to determine accurate elemental and isotropic abundances including solar matter, local interstellar matter and local galactic matter; (2) to study the origin of elements and evolutionary processing in galactic nucleosynthesis, galactic evolution, origin and evolution of the solar system; (3) to study coronal formation and solar-wind acceleration processes; and (4) to study particle acceleration and transport, including coronal shock acceleration, stochastic flare acceleration, interplanetary shock acceleration, and interstellar acceleration and propagation. to accomplish this objective, ACE will perform comprehensive and coordinated determinations of the elemental and isotopic composition of energetic nuclei accelerated on the Sun, in interplanetary space, and from galactic sources. These observations will span five decades in energy, from solar wind to galactic cosmic ray energies, and will cover the element range from H-1 to Zr-40. Comparison of these samples of matter will be used to study the origin and subsequent evolution of both solar system and galactic material by isolating the effects of fundamental processes that include nucleosynthesis, charged and neutral particle separation, bulk plasma acceleration, and the acceleration of suprathermal and high-energy particles.
Derived from text
Spacecraft Design; Payloads; Space Missions; Interstellar Matter; Galactic Evolution; Isotropy; Coronas; Particle Acceleration

20010056851 NASA, Washington, DC USA
Looking Back, Looking Forward: Forty Years of US Human Spaceflight, Parts 1 and 2
May 08, 2001; In English; Videotape: 6 hr. 34 min. 35 sec. playing time, in color, with sound
Report No.(s): NONP-NASA-VT-2001083803; No Copyright; Avail: CASI; V04, Videotape-VHS

This video shows footage from the symposium ’Looking Back, Looking Forward: Forty Years of US Human Spaceflight’ held at the George Washington University on May 8, 2001. John Logsdon, Director of the GWU Space Policy Institute, introduces Daniel Goldin, NASA Administrator, who briefly discusses ’what it has meant to be a spacefaring nation’. A short video gives an overview of the history of spaceflight, including details on the Cold War space race between the US and the Soviet Union, and the first flights in space and to the moon by the US. Charles Murray presents ’Human Space Flight and American Society: The Record So Far’ as the keynote speaker. Session 1, ’The Experience of Space Flight’, consists of the astronauts Bob Crippen, Charles Walker, Mary Ellen Weber, and T.J. Creamer, who discuss their personal experiences with space flight. Session 2

('Perspectives on the Past Forty Years of Human Space Flight'), Session 3 ('Perspectives on the Next Forty Years of US Human Spaceflight'), and the presentation 'The International Space Station and the Future of Human Space Flight' can be found on 'Looking Back, Looking Forward: Forty Years of US Human Spaceflight, These are all in Part 1. Part 2 consists of the following presentations: (1) 'The Space Flight Revolution Revisited" by William Sims Bainbridge; (2) 'Mutual Influences: USSR-US Interactions during the Space Race' by Asif Siddiqi; (3) 'Making Human Space Flight as Safe as Possible' by Fred Gregory; and (4) 'What If? Paths Not Taken" by John Logsdon. Session 3, 'Perspectives on the Next Forty Years of Human Spaceflight', consists of Neil de Grasse Tyson presenting 'Humans or Robots? Choosing Paths of the Frontier of Space Exploration', Robert Zubrin presenting 'Human Space Flight: An Element of American Greatness', Lori Zoloth presenting 'The Ethics of Human Space Flight, and James Garvin presenting 'NASA Faces the Future'. The final presentation is 'The International Space Station and the Future of Human Space Flight' by Bill Readdy, Deputy Associate Administrator fo9r Space Flight, NASA, and William Shepherd, Commander of Expedition 1, International Space Station.
CASI
Conferences; Space Flight; Histories; International Space Station; Space Exploration

20010057599 NASA Langley Research Center, Hampton, VA USA
Apollo 10 - 11
2001; In English; Videotape: 57 min. 43 sec. playing time, in color, with sound
Report No.(s): NONP-NASA-VT-2001089735; No Copyright; Avail: CASI; B03, Videotape-Beta; V03, Videotape-VHS

This video gives overviews of the Apollo 10 and Apollo 11 missions to the moon, including footage from the launches and landings of the Command Module Columbia, which is used for both flights. The Apollo 10 crewmembers, Commander Thomas Stafford, Command Module Pilot John Young, and Lunar Module Pilot Eugene Cernan, are seen as they suit-up in preparation for launch and then as they experiment with the microgravity environment on their way to the moon. The moon's surface is seen in detail as the Command Module orbits at an altitude of 69 miles. The Apollo 11 crewmembers, Commander Neil Armstrong, Command Module Pilot Michael Collins, and Lunar Module Pilot Buzz Aldrin, are seen during various training activities, including simulated lunar gravity training, practicing collecting lunar material, and using the moonquake detector. Footage shows the approach and landing of the Lunar Module Eagle on the moon. Armstrong and Aldrin descend to the moon's surface, collect a sample of lunar dust, and erect the American flag. Eagle's liftoff from the moon is seen.
CASI
Spacecraft Launching; Crew Procedures (Inflight); Crew Procedures (Preflight); Astronaut Training; Moon; Lunar Surface; Spacecraft Landing

15
LAUNCH VEHICLES AND LAUNCH OPERATIONS

Includes all classes of launch vehicles, launch/space vehicle systems, and boosters; and launch operations. For related information see also 18 Spacecraft Design, Testing, and Performance; and 20 Spacecraft Propulsion and Power.

20010054791 Georgia Inst. of Tech., Atlanta, GA USA
A Method of Integrating Aeroheating into Conceptual Reusable Launch Vehicle Design: Evaluation of Advanced Thermal Protection Techniques for Future Reusable Launch Vehicles ***Final Report, 1 Jul. 1999 - 31 Oct. 2000***
Olds, John R., Georgia Inst. of Tech., USA; Cowart, Kris, Georgia Inst. of Tech., USA; June 2001; 192p; In English
Contract(s)/Grant(s): NCC2-5332; No Copyright; Avail: CASI; A09, Hardcopy; A02, Microfiche

A method for integrating Aeroheating analysis into conceptual reusable launch vehicle (RLV) design is presented in this thesis. This process allows for faster turn-around time to converge a RLV design through the advent of designing an optimized thermal protection system (TPS). It consists of the coupling and automation of four computer software packages: MINIVER, TPSX, TCAT, and ADS. MINIVER is an Aeroheating code that produces centerline radiation equilibrium temperatures, convective heating rates, and heat loads over simplified vehicle geometries. These include flat plates and swept cylinders that model wings and leading edges, respectively. TPSX is a NASA Ames material properties database that is available on the World Wide Web. The newly developed Thermal Calculation Analysis Tool (TCAT) uses finite difference methods to carry out a transient in-depth 1-D conduction analysis over the center mold line of the vehicle. This is used along with the Automated Design Synthesis (ADS) code to correctly size the vehicle's thermal protection system (TPS). The numerical optimizer ADS uses algorithms that solve constrained and unconstrained design problems. The resulting outputs for this process are TPS material types, unit thicknesses, and acreage percentages. TCAT was developed for several purposes. First, it provides a means to calculate the transient in-depth conduction seen by the surface of the TPS material that protects a vehicle during ascent and reentry. Along

with the in-depth conduction, radiation from the surface of the material is calculated along with the temperatures at the backface and interior parts of the TPS material. Secondly, TCAT contributes added speed and automation to the overall design process. Another motivation in the development of TCAT is optimization. In some vehicles, the TPS accounts for a high percentage of the overall vehicle dry weight. Optimizing the weight of the TPS will thereby lower the percentage of the dry weight accounted for by the TPS. Also, this will lower the cost of the TPS and the overall cost of the vehicle.
Derived from text
Aerodynamic Heating; Computer Programs; Thermal Protection

20010059347 NASA Marshall Space Flight Center, Huntsville, AL USA
Progress and Status of the 2nd Generation Reusable Launch Vehicle Program
Dumbacher, Daniel L., NASA Marshall Space Flight Center, USA; [2001]; 1p; In English; 52nd International Astronautical Congress, 1-5 Oct. 2001, Toulouse, France; No Copyright; Avail: Issuing Activity; Abstract Only

Safe, low-cost space transportation is the key enabler of the commercial development and civil exploration of space. Human space flight remains a hazardous endeavor in spite of advances in aerospace technology. NASA intends to reduce the resources devoted to routine space operations, thus enabling additional science research, technology development, and exploration activities. NASA developed the Integrated Space Transportation Plan (ISTP) to address the needs for space access. ISTP is a balanced and comprehensive plan that embodies strategies for achieving goals for earth-to-orbit and in-space transportation operations. ISTP calls for near-term safety related upgrades to the Space Shuttle, development of a Crew Return Vehicle, a new Space Launch Initiative (SLI), and development of an Aero-Space Base to provide foundation technology for future space systems. NASA formed the SLI to coordinate the development of the 2nd Generation Reusable Launch Vehicle (RLV) architecture, The SLI is implemented by the 2nd Generation RLV Program Office.
Author
Reusable Launch Vehicles; Spacecraft Launching; Aerospace Systems; Space Transportation; Low Cost; Space Shuttles

20010059598 NASA Glenn Research Center, Cleveland, OH USA
Structural Sizing of a 25,000-lb Payload, Air-Breathing Launch Vehicle For Single-Stage-to-Orbit
Roche, Joseph M., NASA Glenn Research Center, USA; Kosareo, Daniel N., NASA Glenn Research Center, USA; [2000]; 10p; In English; 2000 JANNAF, 13 Nov. 2000, Monterey, CA, USA; Sponsored by NASA, USA
Contract(s)/Grant(s): RTOP 523-61-83; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

In support of NASA's Air-Breathing Launch Vehicle (ABLV) study, a 25,000-lb payload version of the GTX (formerly Trailblazer) reference vehicle concept was developed. The GTX is a vertical lift-off, reusable, single-stage-to-orbit launch vehicle concept that uses hypersonic air-breathing propulsion in a rocket-based combined-cycle (RBCC) propulsion system to reduce the required propellant fraction. to achieve this goal the vehicle and propulsion system must be well integrated both aerodynamically and structurally to reduce weight. This study demonstrates the volumetric and structural efficiency of a vertical takeoff, horizontal landing, hypersonic vehicle with a circular cross section. A departure from the lifting body concepts, this design philosophy is even extended to the engines, which have semicircular nacelles symmetrically mounted on the vehicle. Material candidates with a potential for lightweight and simplicity have been selected from a set of near term technologies (5 to 10 years). to achieve the mission trajectory, preliminary weight estimates show the vehicle's gross lift-off weight is 1.26 x 10(exp 6) lb. The structural configuration of the GTX vehicle and its propulsion system are described. The vehicle design benefits are presented, and key technical issues are highlighted.
Derived from text
Air Breathing Boosters; Launch Vehicles; Vertical Takeoff; Single Stage to Orbit Vehicles; Payloads

17
SPACE COMMUNICATIONS, SPACECRAFT COMMUNICATIONS, COMMAND AND TRACKING

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

20010058730 Los Alamos National Lab., NM USA
High Explosive Radio Telemetry on Exoatmospheric Re-entry Flight Vehicle
Bracht, R.; Pasquale, R. V.; Petersen, T.; Oct. 26, 2000; 18p; In English; International Telemetry Conference, 23-26 Oct. 2000, San Diego, CA, USA
Report No.(s): PB2001-105672; LA-UR-00-2877; No Copyright; Avail: National Technical Information Service (NTIS)

The High Explosive Radio Telemetry (HERT) is a telemetry system that utilizes a novel polar differential 16-QAM to achieve a maximum data rate of 100 Mbps during a destructive event. Sixty-four channels of nearly simultaneous events are captured and timed with 10-nanosecond resolution. All data is initially transmitted in less than 20 microseconds. Data redundancy and error detection is included in the encoding format. The main telemetry module is approximately 13 cubic inches in size and has optical inputs. It consumes about 5 watts of input power. A modular 10-watt transmitter is attached which is operated in pulse mode. Though HERT has successfully taken data in close proximity to an explosive event, data has never been collected in HERTs intended environment-a speeding, rotating, exoatmospheric re-entry flight vehicle. Recent tests have been performed at Kwajalein Pacific test range to verify theoretical data. This paper will discuss some background on the HERT system, the 16-QAM constellation, and the results of the test, including a comparison of simulation and flight test data.
NTIS
Radio Telemetry; Reentry Vehicles

18
SPACECRAFT DESIGN, TESTING AND PERFORMANCE

Includes satellites; space platforms; space stations; spacecraft systems and components such as thermal and environmental controls; and spacecraft control and stability characteristics. 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 and Safety.

20010054454 NASA Johnson Space Center, Houston, TX USA
Advanced Structural and Inflatable Hybrid Spacecraft Module
Schneider, William C., Inventor, NASA Johnson Space Center, USA; delaFuente, Horacio M., Inventor, NASA Johnson Space Center, USA; Edeen, Gregg A., Inventor, NASA Johnson Space Center, USA; Kennedy, Kriss J., Inventor, NASA Johnson Space Center, USA; Lester, James D., Inventor, NASA Johnson Space Center, USA; Gupta, Shalini, Inventor, NASA Johnson Space Center, USA; Hess, Linda F., Inventor, NASA Johnson Space Center, USA; Lin, Chin H., Inventor, NASA Johnson Space Center, USA; Malecki, Richard H., Inventor, NASA Johnson Space Center, USA; Raboin, Jasen L., Inventor, NASA Johnson Space Center, USA; May 15, 2001; 28p; In English
Patent Info.: Filed 25 Jan. 1999; NASA-Case-MSC-22900-1; US-Patent-6,231,010; US-Patent-Appl-SN-236785; No Copyright; Avail: CASI; A01, Microfiche; A03, Hardcopy

An inflatable module comprising a structural core and an inflatable shell, wherein the inflatable shell is sealingly attached to the structural core. In its launch configuration, the wall thickness of the inflatable shell is collapsed by vacuum. Also in this configuration, the inflatable shell is collapsed and efficiently folded around the structural core. Upon deployment, the wall thickness of the inflatable shell is inflated; whereby the inflatable shell itself, is thereby inflated around the structural core, defining therein a large enclosed volume. A plurality of removable shelves are arranged interior to the structural core in the launch configuration. The structural core also includes at least one longeron that, in conjunction with the shelves, primarily constitute the rigid, strong, and lightweight load-bearing structure of the module during launch. The removable shelves are detachable from their arrangement in the launch configuration so that, when the module is in its deployed configuration and launch loads no longer exist, the shelves can be rearranged to provide a module interior arrangement suitable for human habitation and work. In the preferred embodiment, to provide efficiency in structural load paths and attachments, the shape of the inflatable shell is a cylinder with semi-toroidal ends.
Official Gazette of the U.S. Patent and Trademark Office
Spacecraft Modules; Inflatable Spacecraft; Assemblies; Racks (Frames)

20010055694 NASA Langley Research Center, Hampton, VA USA
Afterbody Heating Characteristics of a Proposed Mars Sample Return Orbiter
Horvath, Thomas J., NASA Langley Research Center, USA; Heiner, Nicholas C., NASA Langley Research Center, USA; Olguin, Daniella M., NASA Langley Research Center, USA; Cheatwood, F. McNeil, NASA Langley Research Center, USA; Gnoffo, Peter A., NASA Langley Research Center, USA; [2001]; 20p; In English; 35th AIAA Thermophysics Conference, 11-14 Jun. 2001, Anaheim, CA, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA; Original contains color illustrations
Report No.(s): AIAA Paper 2001-3068; Copyright Waived; Avail: CASI; A03, Hardcopy; A01, Microfiche

Aeroheating wind-tunnel tests were conducted on a 0.028 scale model of an orbiter concept considered for a possible Mars sample return mission. The primary experimental objectives were to characterize hypersonic near wake closure and determine

if shear layer impingement would occur on the proposed orbiter afterbody at incidence angles necessary for a Martian aerocapture maneuver. Global heat transfer mappings, surface streamline patterns, and shock shapes were obtained in the NASA Langley 20-inch Mach 6 Air and CF4 Tunnels for post-normal shock Reynolds numbers (based on forebody diameter) ranging from 1,400 to 415,000, angles of attack ranging from -5 to 10 degrees at 0, 3, and 6 deg sideslip, and normal-shock density, ratios of 5 and 12. Laminar, transitional, and turbulent shear layer impingement on the cylindrical afterbody was inferred from the measurements and resulted in a localized heating maximum that ranged from 40 to 75% of the reference forebody stagnation point heating. Comparison of laminar heating prediction to experimental measurement along the orbiter afterbody highlight grid alignment challenges associated with numerical simulation of three-dimensional separated wake flows.
Author
Afterbodies; Wind Tunnel Tests; Aerodynamic Heating; Heat Transfer; Computerized Simulation

20010056605 NASA Langley Research Center, Hampton, VA USA
Aerothermodynamic Environment Definition for the Genesis Sample Return Capsule
Cheatwood, F. McNeil, NASA Langley Research Center, USA; Merski, N. Ronald, Jr., NASA Langley Research Center, USA; Riley, Christopher J., NASA Langley Research Center, USA; Mitcheltree, Robert A., NASA Langley Research Center, USA; [2001]; 18p; In English; 35th AIAA Thermophysics Conference, 11-14 Jun. 2001, Anaheim, CA, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA; Original contains color illustrations
Report No.(s): AIAA Paper 2001-2889; Copyright Waived; Avail: CASI; A03, Hardcopy; A01, Microfiche

NASA's Genesis sample return mission will be the first to return material from beyond the Earth-Moon system. NASA Langley Research Center supported this mission with aerothermodynamic analyses of the sample return capsule. This paper provides an overview of that effort. The capsule is attached through its forebody to the spacecraft bus. When the attachment is severed prior to Earth entry, forebody cavities remain. The presence of these cavities could dramatically increase the heating environment in their vicinity and downstream. A combination of computational fluid dynamics calculations and wind tunnel phosphor thermography tests were employed to address this issue. These results quantify the heating environment in and around the cavities, and were a factor in the decision to switch forebody heat shield materials. A transition map is developed which predicts that the flow aft of the penetrations will still be laminar at the peak heating point of the trajectory. As the vehicle continues along the trajectory to the peak dynamic pressure point, fully turbulent flow aft of the penetrations could occur. The integrated heat load calculations show that a heat shield sized to the stagnation point levels will be adequate for the predicted environment aft of the penetrations.
Author
Aerothermodynamics; Cavities; Wind Tunnel Tests; Heating; Forebodies

20010056680 NASA Marshall Space Flight Center, Huntsville, AL USA
Mars Global Reference Atmospheric Model 2001 Version (Mars-GRAM 2001): Users Guide
Justus, C. G., Computer Sciences Corp., USA; Johnson, D. L., NASA Marshall Space Flight Center, USA; April 2001; 66p; In English
Report No.(s): NASA/TM-2001-210961; NAS 1.15:210961; M-1012; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

This document presents Mars Global Reference Atmospheric Model 2001 Version (Mars-GRAM 2001) and its new features. As with the previous version (mars-2000), all parameterizations fro temperature, pressure, density, and winds versus height, latitude, longitude, time of day, and season (Ls) use input data tables from NASA Ames Mars General Circulation Model (MGCM) for the surface through 80-km altitude and the University of Arizona Mars Thermospheric General Circulation Model (MTGCM) for 80 to 70 km. Mars-GRAM 2001 is based on topography from the Mars Orbiter Laser Altimeter (MOLA) and includes new MGCM data at the topographic surface. A new auxiliary program allows Mars-GRAM output to be used to compute shortwave (solar) and longwave (thermal) radiation at the surface and top of atmosphere. This memorandum includes instructions on obtaining Mars-GRAN source code and data files and for running the program. It also provides sample input and output and an example for incorporating Mars-GRAM as an atmospheric subroutine in a trajectory code.
Author
Mars Atmosphere; Atmospheric General Circulation Models; Mars Surface; Parameterization; Atmospheric Models; Atmospheric Circulation

20010056933 Search for Extraterrestrial Intelligence Inst., Mountain View, CA USA

Bring'em Back Alive or at Least Carefully

Race, Margaret S., Search for Extraterrestrial Intelligence Inst., USA; Rummel, John D., Search for Extraterrestrial Intelligence Inst., USA; To the Stars; Jan - Feb. 1999, pp. 37-40; In English; Copyright; Avail: Issuing Activity

Within the next decade, the world's space agencies plan to launch a variety of robotic spacecraft that will return samples from the surface of Mars, the tail of a comet, the nucleus of a comet, the surface of an asteroid, and the solar wind. Most of these places are not considered likely spots for life, but any mission returning from a location with the potential for harboring life will require special containment and handling because of the possible inclusion of living entities within returned samples. In its 1997 report on sample return from Mars, the Space Studies Board of the National Research Council (NRC) noted that the only risk of significant adverse effects would be from returning a replicating organism. Furthermore, the report noted: 'While the probability of returning a replicating biological entity in a sample from Mars' is judged to be low and the risk of pathogenic or ecological effects is lower still, the risk is not zero. Therefore, it is reasonable that NASA adopt a prudent approach, erring on the side of caution and safety when dealing with returned samples. More recently, a 1998 NRC report on small solar system bodies (asteroids, comets, planetary satellites, and interplanetary dust) recommended a similarly cautious approach for samples returned from anywhere else within the solar system that could have environmental conditions conducive for harboring life. We have not detected life elsewhere in the solar system, at least not yet. Nonetheless, the rationale behind the conservative approach to sample handling is similar to the environmental, health, and safety measures taken on Earth when transporting or handling infectious agents or importing non-native organisms to a new area. Better safe than sorry.

Author

Containment; Safety Management; Sample Return Missions; Extraterrestrial Life; Protection

20010059345 Sverdrup Technology, Inc., Huntsville, AL USA

Comparison of the NASCAP/GEO, POLAR, SEE Charging Handbook, and NASCAP-2K.1 Spacecraft Charging Codes

Neergaard, Linda E., Sverdrup Technology, Inc., USA; Minow, Joseph, Sverdrup Technology, Inc., USA; McCollum, Matt, NASA Marshall Space Flight Center, USA; Cooke, David, Air Force Research Lab., USA; Katz, Ira, Maxwell Technologies, Inc., USA; Maxwell, M. Mandell, Maxwell Technologies, Inc., USA; Davis, V., Maxwell Technologies, Inc., USA; Hilton, J., Maxwell Technologies, Inc., USA; Jan. 12, 2001; 1p; In English; 7th Spacecraft Charging Technology Conference, 23-27 Apr. 2001, Noordwijk, Netherlands

Contract(s)/Grant(s): NAS8-00187; No Copyright; Avail: Issuing Activity; Abstract Only

The NASA Charging Analyzer Program (NASCAP) spacecraft charging software developed by Maxwell Technologies has been widely used for the past fifteen to twenty years in satellite design and investigation of spacecraft charging related anomalies. Individual versions of the NASCAP software are available for use in low inclination, low Earth orbit environments (NASCAP[LEO) and geostationary orbit environments (NASCAP/GEO). In addition, the Potentials of Large objects in the Auroral Region (POLAR) code is available for use in LEO polar orbit environments. NASCAP/GEO and POLAR were both written in the 1980's using algorithms appropriate for the computers of the time. They solve the Poisson-Vlasov system for currents and densities assuming limited speed and memory of computer systems standard for the day. In addition, use of the charging models requires individual input files that are not readily transported into the various codes to facilitate comparison of results by the user.

Author

NASA Programs; Spacecraft Charging; Software Development Tools; Satellite Design; Computerized Simulation

20010059377 NASA Glenn Research Center, Cleveland, OH USA

Managing Risk for Thermal Vacuum Testing of the International Space Station Radiators

Carek, Jerry A., NASA Glenn Research Center, USA; Beach, Duane E., NASA Glenn Research Center, USA; Remp, Kerry L., NASA Glenn Research Center, USA; [2000]; 14p; In English; 19th Aerospace Testing Seminar, 2-5 Oct. 2000, Manhattan Beach, CA, USA; Sponsored by Advanced Thermal Systems, Inc., USA

Contract(s)/Grant(s): RTOP 282-30-07; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The International Space Station (ISS) is designed with large deployable radiator panels that are used to reject waste heat from the habitation modules. Qualification testing of the Heat Rejection System (HRS) radiators was performed using qualification hardware only. As a result of those tests, over 30 design changes were made to the actual flight hardware. Consequently, a system level test of the flight hardware was needed to validate its performance in the final configuration. A full thermal vacuum test was performed on the flight hardware in order to demonstrate its ability to deploy on-orbit. Since there is an increased level of risk associated with testing flight hardware, because of cost and schedule limitations, special risk mitigation procedures were developed and implemented for the test program, This paper introduces the Continuous Risk Management process that was

utilized for the ISS HRS test program. Testing was performed in the Space Power Facility at the NASA Glenn Research Center, Plum Brook Station located in Sandusky, Ohio. The radiator system was installed in the 100-foot diameter by 122-foot tall vacuum chamber on a special deployment track. Radiator deployments were performed at several thermal conditions similar to those expected on-orbit using both the primary deployment mechanism and the back-up deployment mechanism. The tests were highly successful and were completed without incident.
Author
Performance Tests; Thermal Vacuum Tests; Risk; Heat Radiators

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; 15 Launch Vehicles and Launch Operations; and 44 Energy Production and Conversion.

20010057212 Vanderbilt Univ., Materials Science and Engineering, USA
Investigation of the Relationship Between Undercooling and Solidification Velocity
Altgilbers, A. A., Vanderbilt Univ., USA; Hofmeister, W. H., Vanderbilt Univ., USA; Bayuzick, R. J., Vanderbilt Univ., USA; Microgravity Materials Science Conference 2000; March 2001; Volume 1, pp. 76-81; In English; See also 20010057199; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A02, Hardcopy

In the past few decades, several investigators have focused their efforts to correctly predict the solidification velocity as a function of undercooling for many materials. Though significant progress has been made in this area of research, there have been difficulties in unifying theoretical models with the ever increasing volume of measured solidification velocity data. The theory for relating the solidification velocity to undercooling developed by Boettinger, Coriel, and Trivedi (the BCT theory) has been the most successful and most widely accepted theory to date. The BCT theory is based on the early work of Ivantsov, who approximated the growth of a single dendrite as a paraboloid of revolution. Despite the many successes of the BCT theory, the model appears to breakdown at large undercoolings. The focus of this work is to further expand the understanding of the solidification process by measuring the solidification velocity as a function of undercooling in dilute alloys, and then using this data along with microstructural analysis to further develop the models for solidification kinetics. In order to characterize the parameters that influence the solidification process, several metallic systems are being investigated. The selected alloy systems include those systems that have a wide range of partition coefficients and differing liquid diffusion coefficients. by bracketing these parameters it is hoped that further understanding of the solidification process in alloys will be attained. The alloy systems that have been selected for this study are: Ni-Ti, Ni-Si, Ni-Sn, TI-Ni, and Ti-Al. In addition, measurements in the Ti-Al intermetallic system, containing small additions of vanadium and niobium are of interest. The solidification velocity is measured using a 1 MHz thermal imaging system (HSDA 96)3 to track the solid/liquid interface as it proceeds across an electro-magnetically levitated drop. Simultaneously, the undercooling temperature is recorded using an optical pyrometer. This technique and the subsequent data analysis have been well established at Vanderbilt University. Microstructural analysis of the processed droplets is an important part of understanding the mechanisms involved in the solidification process. Optical microscopy and SEM imaging is used to characterize the dendritic growth, while microprobe analysis is employed to characterize the solute distribution after solidification.
Author
Solidification; Velocity; Supercooling; Microstructure

23
CHEMISTRY AND MATERIALS (GENERAL)

Includes general research topics related to the composition, properties, structure, and use of chemical compounds and materials as they relate to aircraft, launch vehicles, and spacecraft. For specific topics in chemistry and materials see categories 24 through 29. For astrochemistry see category 90 Astrophysics.

20010057199 NASA Marshall Space Flight Center, Huntsville, AL USA
Microgravity Materials Science Conference 2000, Volume 1
Ramachandran, Narayanan, Editor, Universities Space Research Association, USA; Bennett, Nancy, Editor, Universities Space Research Association, USA; McCauley, Dannah, Editor, Alabama Univ., USA; Murphy, Karen, Editor, Morgan Research Corp.,

USA; Poindexter, Samantha, Editor, Universities Space Research Association, USA; Microgravity Materials Science Conference 2000; March 2001; 342p; In English; 4th; Microgravity Materials Science Conference 2000, 6-8 June 2000, Huntsville, AL, USA; See also 20010057200 through 20010057255; CD-ROM contains the entire Conference Proceedings presented in PDF format Report No.(s): NASA/CP-2001-210827/VOL1; M-1003/VOL1; NONP-NASA-CD-2001082963; NAS 1.55:210827/VOL1; No Copyright; Avail: CASI; C01, CD-ROM; A15, Hardcopy; A03, Microfiche

This is Volume 1 of 3 of the 2000 Microgravity Material Science Conference that was held June 6-8 at the Von Braun Center, Huntsville, Alabama. It was organized by the Microgravity Materials Science Discipline Working Group, sponsored by the Microgravity Research Division (MRD) at NASA Headquarters, and hosted by NASA Marshall Space Flight Center and the Alliance for Microgravity Materials Science and Applications (AMMSA). It was the fourth NASA conference of this type in the microgravity materials science discipline. The microgravity science program sponsored approx. 200 investigators, all of whom made oral or poster presentations at this conference. In addition, posters and exhibits covering NASA microgravity facilities, advanced technology development projects sponsored by the NASA Microgravity Research Division at NASA Headquarters, and commercial interests were exhibited. The purpose of the conference was to inform the materials science community of research opportunities in reduced gravity and to highlight the Spring 2001 release of the NASA Research Announcement (NRA) to solicit proposals for future investigations. It also served to review the current research and activities in materials science, to discuss the envisioned long-term goals. and to highlight new crosscutting research areas of particular interest to MRD. The conference was aimed at materials science researchers from academia, industry, and government. A workshop on in situ resource utilization (ISRU) was held in conjunction with the conference with the goal of evaluating and prioritizing processing issues in Lunar and Martian type environments. The workshop participation included invited speakers and investigators currently funded in the material science program under the Human Exploration and Development of Space (HEDS) initiative. The conference featured a plenary session every day with an invited speaker that was followed by three parallel breakout sessions in subdisciplines. Attendance was close to 350 people. Posters were available for viewing during the conference and a dedicated poster session was held on the second day. Nanotechnology radiation shielding materials, Space Station science opportunities, biomaterials research, and outreach and educational aspects of the program were featured in the plenary talks. This volume, the first to be released on CD-ROM for materials science, is comprised of the research reports submitted by the Principal Investigators at the conference. Author

Conferences; Microgravity Applications; Crystal Growth; Microgravity; Gravitational Effects; Directional Solidification (Crystals)

20010057202 Case Western Reserve Univ., Dept. of Mechanical and Aerospace Engineering, Cleveland, OH USA

Vibrations and G-Jitter: Transport Disturbances Due to Residual Acceleration During Low Gravity Directional Solidification and Diffusion Experiments

Alexander, J. Iwan D., Case Western Reserve Univ., USA; Kizito, J. P., National Center for Microgravity Research on Fluids and Combusiton, USA; Kassemi, M., National Center for Microgravity Research on Fluids and Combusiton, USA; Microgravity Materials Science Conference 2000; March 2001; Volume 1, pp. 22-23; In English; See also 20010057199; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

The proposed research involves a four-year program of ground-based research leading to the definition of a set of benchmark flight experiments. The experimental objectives are to characterize the response of heat and species transport in a directionally solidifying model transparent alloy system subject to well-characterized imposed vibrations and, ultimately, to spacecraft residual acceleration. The experiments will: Quantify the effects of residual acceleration on transport during directional solidification Investigate, as part of the flight experiment definition, modulated 1 g convective transport in solidifying succinonitrile-ethanol (SCN-E) and succinonitrile-water (SCN-W) melts using high and low frequency translational and rotational vibrations; Investigate single and two-liquid phase melt responses; Compare thermo-solutal and dominantly thermal convective responses to vibration (facilitated by the weak dependence of SCN-W density on composition); Investigate the possibility of using vibration for transport control (e.g., for melt homogenization or rehomogenization).

Derived from text

Vibration; Diffusion; Acceleration; Vibration Damping; Heat Transfer

20010057210 Alabama Univ., Center for Microgravity and Materials Research, Huntsville, AL USA

Self-Diffusion in Liquid Elements

Banish, R. Michael, Alabama Univ., USA; Jalbert, Lyle B., Alabama Univ., USA; Alexander, J. Iwan D., Case Western Reserve Univ., USA; Microgravity Materials Science Conference 2000; March 2001; Volume 1, pp. 63-69; In English; See also 20010057199; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A02, Hardcopy

The final goal of this research is to establish the liquid-state, self-diffusivity temperature dependence D(T) for selected elements. This requires data sets of sufficient accuracy such that a clear statistical correlation can be drawn between these data and the (existing) theories. At the present time, the scatter in the data sets is too large to make any reliable prediction of the best fit. In order to obtain the most reliable correlations diffusivities will be determined over the majority of the elements' liquid range (up to 14000 C). We will then interpret the measured self-diffusivity data in terms of diffusion mechanisms and associated liquid structures. With increasing 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. In particular, there is little insight into the temperature dependence of diffusivities and its correlation to the temperature-dependent liquid structure of an element. Currently, the differences between several theoretical predictions are often less than those between different sets of data for the same system. Hence, for both theoretical and technological developments, there is a clear need for diffusivity measurements of improved accuracy and precision for a large variety of elements over wide temperature ranges.
Derived from text
Liquid Metals; Diffusion; Temperature Dependence; Diffusivity

20010057236 Pennsylvania Univ., Center for Bioactive Materials and Tissue Engineering, Philadelphia, PA USA
Reactions and Surface Transformations of Bioactive Material in a Simulated Microgravity Environment: An Experimental and Numerical Study
Ducheyne, P., Pennsylvania Univ., USA; Radin, S., Pennsylvania Univ., USA; Ayyaswamy, P. S., Pennsylvania Univ., USA; Gao, H., Pennsylvania Univ., USA; Microgravity Materials Science Conference 2000; March 2001; Volume 1, pp. 188-192; In English; See also 20010057199; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A02, Hardcopy

Simulated microgravity (mu-g) conditions of NASA designed Rotating Wall Bioreactor Vessels (RWVs) have been found favorable for the growth of in vitro 3-D bone-like tissue. Such 3-D tissue growth could have wide clinical applications. The 3-D bone growth in RWVs is facilitated by the use of microcarriers; which provide structural support. Microcarrier materials which promote cellular function (bioactive materials) not only provide structural support but also enhance 3-D bone tissue formation. Based on extensive physico-chemical and biochemical analyses, bioactive glass (BG) has been demonstrated to be an attractive candidate for use as bioactive microcarrier material. BG surface reactions are closely related to its stimulatory effect on bone cell function. Since the nature of BG reactions under the simulated (mu-g) conditions of RWVs is unknown, the objective of this study is to analyze the BG behavior in the RWV environment using experimental and numerical methods.
Author
Microgravity; Surface Reactions; Gravitational Effects; Weightlessness Simulation; Tissues (Biology)

20010057247 NASA Marshall Space Flight Center, Huntsville, AL USA
Use of Computed Tomography for Characterizing Materials Grown Terrestrially and in Microgravity
Gillies, Donald C., NASA Marshall Space Flight Center, USA; Engel, H. P., Wyle Labs., Inc., USA; Microgravity Materials Science Conference 2000; March 2001; Volume 1, pp. 244-245; In English; See also 20010057199; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A01, Hardcopy

The purpose behind this work is to provide NASA Principal Investigators (PIs) rapid information, nondestructively, about their samples. This information will be in the form of density values throughout the samples, especially within slices 1 mm high. With correct interpretation and good calibration, these values will enable the PI to obtain macro chemical compositional analysis for his/her samples. Alternatively, the technique will provide information about the porosity level and its distribution within the sample. Experience gained with a NASA Microgravity Research Division-sponsored Advanced Technology Development (ATD) project on this topic has brought the technique to a level of maturity at which it has become a viable characterization tool for many of the Materials Science Pls, but with equipment that could never be supported within their own facilities. The existing computed tomography (CT) facility at NASA's Kennedy Space Center (KSC) is ideally situated to furnish information rapidly and conveniently to PIs, particularly immediately before and after flight missions.
Author
Chemical Analysis; Nondestructive Tests; Computer Aided Tomography

20010057248 Rensselaer Polytechnic Inst., Troy, NY USA

Follow-on Research Activities for the Rensselaer Isothermal Dendritic Growth Experiment (RIDGE)

LaCombe, J. C., Rensselaer Polytechnic Inst., USA; Koss, M. B., Rensselaer Polytechnic Inst., USA; Lupulescu, A. O., Rensselaer Polytechnic Inst., USA; Frei, J. E., Rensselaer Polytechnic Inst., USA; Giummarra, C., Rensselaer Polytechnic Inst., USA; Glicksman, M. E., Rensselaer Polytechnic Inst., USA; Microgravity Materials Science Conference 2000; March 2001; Volume 1, pp. 246-252; In English; See also 20010057199; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A02, Hardcopy

The RIDGE effort continues the aegis of the earlier, NASA-sponsored, Isothermal Dendritic Growth Experiment (IDGE) series of experiments through the continued analysis of microgravity data acquired during these earlier space flights. The preliminary observations presented here demonstrate that there are significant differences between SCN and the more anisotropic PVA dendrites. The side branch structure becomes amplified only further behind the tip, and the interface shape is generally wider (i.e. more hyperbolic than parabolic) in PVA than in SCN. These characteristics are seen to affect the process of heat transport. Additionally, the dendrites grown during the fourth USA Microgravity Payload (USMP-4) exhibit time-dependent growth characteristics and may not always have reached steady-state growth during the experiment.

Author

Crystal Growth; Dendritic Crystals; Microgravity; Shapes; Isothermal Processes

20010057249 NASA Glenn Research Center, Cleveland, OH USA

The Isothermal Dendritic Growth Experiment (IDGE)

Glicksman, M. E., Rensselaer Polytechnic Inst., USA; Koss, M. B., Rensselaer Polytechnic Inst., USA; LaCombe, J. C., Rensselaer Polytechnic Inst., USA; Lupulescu, A. O., Rensselaer Polytechnic Inst., USA; Frei, J. E., Rensselaer Polytechnic Inst., USA; Guimarra, C., Rensselaer Polytechnic Inst., USA; Malarik, D. C., NASA Glenn Research Center, USA; Microgravity Materials Science Conference 2000; March 2001; Volume 1, pp. 253-258; In English; See also 20010057199; CD-ROM contains the entire Conference Proceedings presented in PDF format

Contract(s)/Grant(s): NAS3-25368; No Copyright; Avail: CASI; A02, Hardcopy

Dendritic solidification is one of the simplest examples of pattern formation where a structureless melt evolves into a ramified crystalline microstructure; it is a common mode of solidification in many materials, but especially so in metals and alloys. There is considerable engineering interest in dendrites because of the role dendrites play in the determination of microstructure, and thereby in influencing the physical properties of cast metals and alloys. Dendritic solidification provides important examples of non-equilibrium physics, pattern formation dynamics, and models for computational condensed matter and material physics. Current theories of dendritic growth generally couple diffusion effects in the melt with the physics introduced by the interface. Unfortunately, in terrestrial based experiments, convective effects in the melt alter the growth process in such a manner as to prevent definitive analysis of convective, diffusive or interfacial effects. Thus, the effective elimination of convection in the melt by operating experiments on orbit were required to produce high-fidelity data needed for achieving further progress. This simple fact comprised the scientific justification for the IDGE.

Author

Crystal Growth; Dendritic Crystals; Microstructure; Solidification; Microgravity; Space Processing

20010057250 NASA Marshall Space Flight Center, Huntsville, AL USA

Evolution of Local Microstructures: Spatial Instabilities of Coarsening Clusters

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; Microgravity Materials Science Conference 2000; March 2001; Volume 1, pp. 259-266; In English; See also 20010057199; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A02, Hardcopy

This work examines the diffusional growth of discrete phase particles dispersed within a matrix. Engineering materials are often 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 diffusion-limited and 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. Competitive kinetics of these processes dictates 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)=0 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 predicted by TLS is proportional to V(exp 1/2)(sub v) whereas others suggest V(exp 1/3)(sub v).This issue has been addressed recently by simulation studies at low volume fractions in three dimensions by members of the Rensselaer/MSFC team.
Author
Microstructure; Ostwald Ripening; Phase Transformations; Coarseness; Molecular Clusters; Mathematical Models

20010057251 Georgia Inst. of Tech., School of Materials Science and Engineering, Atlanta, GA USA
Effect of Gravity on the Evolution of Spatial Arrangement of Features in Microstructures: A Quantitative Approach
Gokhale, A. M., Georgia Inst. of Tech., USA; Tewari, A., Georgia Inst. of Tech., USA; Microgravity Materials Science Conference 2000; March 2001; Volume 1, pp. 267-272; In English; See also 20010057199; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A02, Hardcopy

A microstructure is a collection of volumes, internal-surfaces, lines, and points. Depending on its dimensionality, each microstructural feature has associated with it size, shape, volume, surface area, curvature, etc., and location. The distribution of relative locations of microstructural features is manifested in the spatial patterns, correlations, clustering, short and long range interactions, microstructural gradients, segregation, etc. Evolution of spatial arrangement of microstructural features is an aspect of microstructure development that may be significantly affected by gravity, particularly when liquid phases are present during the evolution processes. The objectives of this research have been to develop Stereology and image analyses based techniques for quantitative characterization of spatial arrangement of features in three-dimensional microstructure, and apply these techniques to quantify the effect of gravity of evolution of microstructure during liquid phase sintering (LPS). The evolution of bivariate coordination number distribution, first, second, and third nearest neighbor distance, and true grain size distributions of tungsten grains have been characterized. It is observed that in both ground-based as well as microgravity-processed specimens the tungsten grains form almost completely connected network. Therefore, absence of gravity does not lead to a liquid phase sintered microstructure consisting of discrete and separate tungsten grains uniformly distributed in the Fe-Ni alloy matrix. The quantitative microstructural data have revealed interesting trends concerning the effect of gravity on evolution coordination number distribution and nearest neighbor distributions of the tungsten grains in these liquid phase sintered microstructures. The digital images of three-dimensional microstructures are presented in the next section. The quantitative microstructural data and observations are discussed in the subsequent sections.
Derived from text
Gravitational Effects; Microstructure; Microgravity; Image Analysis

20010057254 NASA Marshall Space Flight Center, Huntsville, AL USA
Solidification Processing of Immiscible Liquids in the Presence of Applied Ultrasonic Energy
Grugel, R. N., NASA Marshall Space Flight Center, USA; Fedoseyev, A. I., Alabama Univ., USA; Kim, S., Hoseo Univ., Korea, Republic of; Microgravity Materials Science Conference 2000; March 2001; Volume 1, pp. 282; In English; See also 20010057199; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

Uniform microstructural distribution during solidification of immiscible liquids (e.g., oil and water; aluminum and lead) on Earth is hampered by inherent density differences between the phases. Microgravity processing minimizes settling but segregation still occurs due to gravity independent wetting and coalescence phenomena. Experiments with the transparent organic, metal analogue, succinonitrile-glycerol system were conducted in conjunction with applied ultrasonic energy. The processing parameters associated with this technique have been evaluated in view of optimizing dispersion uniformity. Characterization of the experimental results in terms of a modeling effort will also be presented,
Author
Solidification; Ultrasonic Radiation; Microstructure

20010057255 Ohio State Univ., Dept. of Materials Science and Engineering, Columbus, OH USA
Inter-Diffusion in the Presence of Free Convection
Gupta, P. K., Ohio State Univ., USA; Hu, Z., Ohio State Univ., USA; Microgravity Materials Science Conference 2000; March 2001; Volume 1, pp. 283-287; In English; See also 20010057199; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A01, Hardcopy

Compositional changes during isothermal interdiffusion generally cause density variations in a diffusing system. Such compositionally-induced density variations give rise to free convection in ground based experiments and interfere with the analysis of composition profiles for determining interdiffusion coefficients. One method to eliminate the effect of free convection

during interdiffusion is to carry out experiments in zero-gravity conditions. Another way is to examine the influence of convection and correct for this effect when analyzing for diffusion coefficients in ground based experiments. This paper describes experimental results on interdiffusion in PbO-SiO2 melts under conditions both stable and unstable with respect to free convection.
Author
Free Convection; Diffusion; Microgravity

20010057256 NASA Marshall Space Flight Center, Huntsville, AL USA
Microgravity Materials Science Conference 2000, Volume 2
Narayanan, Ramachandran, Editor, Universities Space Research Association, USA; Bennett, Nancy, Editor, Universities Space Research Association, USA; McCauley, Dannah, Editor, Alabama Univ., USA; Murphy, Karen, Editor, Morgan Research Corp., USA; Poindexter, Samantha, Editor, Universities Space Research Association, USA; Microgravity Materials Science Conference 2000; March 2001; 252p; In English; 4th; Microgravity Materials Science Conference 2000, 6-8 June 2000, Huntsville, AL, USA; See also 20010057257 through 20010057301; CD-ROM contains the entire Conference Proceedings presented in PDF format
Report No.(s): NASA/CP-2000-210827/VOL2; M-1003/VOL2; NONP-NASA-CD-2001082994; NAS 1.55:210827/VOL2; No Copyright; Avail: CASI; C01, CD-ROM; A12, Hardcopy; A03, Microfiche

This is Volume 2 of 3 of the 2000 Microgravity Materials Science Conference that was held June 6-8 at the Von Braun Center, Huntsville, Alabama. It was organized by the Microgravity Materials Science Discipline Working Group, sponsored by the Microgravity Research Division (MRD) at NASA Headquarters, and hosted by NASA Marshall Space Flight Center and the Alliance for Microgravity Materials Science and Applications (AMMSA). It was the fourth NASA conference of this type in the Microgravity materials science discipline. The microgravity science program sponsored approx. 200 investigators, all of whom made oral or poster presentations at this conference- In addition, posters and exhibits covering NASA microgravity facilities, advanced technology development projects sponsored by the NASA Microgravity Research Division at NASA Headquarters, and commercial interests were exhibited. The purpose of the conference %%,its to inform the materials science community of research opportunities in reduced gravity and to highlight the Spring 2001 release of the NASA Research Announcement (NRA) to solicit proposals for future investigations. It also served to review the current research and activities in material,, science, to discuss the envisioned long-term goals. and to highlight new crosscutting research areas of particular interest to MRD. The conference was aimed at materials science researchers from academia, industry, and government. A workshop on in situ resource utilization (ISRU) was held in conjunction with the conference with the goal of evaluating and prioritizing processing issues in Lunar and Martian type environments. The workshop participation included invited speakers and investigators currently funded in the material science program under the Human Exploration and Development of Space (HEDS) initiative. The conference featured a plenary session every day with an invited speaker that was followed by three parallel breakout sessions in subdisciplines. Attendance was close to 350 people, Posters were available for viewing during the conference and a dedicated poster session was held on the second day. Nanotechnology, radiation shielding materials, Space Station science opportunities, biomaterials research, and outreach and educational aspects of the program were featured in the plenary talks. This volume, the first to be released on CD-ROM for materials science, is comprised of the research reports submitted by the Principal Investigators at the conference.
Author
Conferences; Crystal Growth; Microgravity; Microgravity Applications; Gravitational Effects; Directional Solidification (Crystals)

20010057269 Northeastern Univ., Dept. of Physics, Boston, MA USA
Phase-Field Simulations of Equiaxed Dendritic Growth at Low Undercooling: Confronting Theory and Experiment
Karma, Alain, Northeastern Univ., USA; Microgravity Materials Science Conference 2000; March 2001; Volume 2, pp. 340-344; In English; See also 20010057256; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A01, Hardcopy

Dendrites are complex growth morphologies that are the building blocks of the microstructure of many important commercial alloys processed by solidification. Although dendritic growth has been the main focus of fundamental research in pattern formation and crystal growth for decades, it is only quite recently that numerical simulation techniques have reached the point of making realistic predictions that can be meaningfully compared with experiments, or used to critically test analytical theories. Among various techniques that have been developed, the phase-field approach has clearly emerged as the leading computational technique for simulating dendritic growth and other interfacial pattern formation phenomena both efficiently and accurately in three dimensions (3-D). The goal of this new project is to carry out fully quantitative phase-field simulations of 3-D equiaxed

dendritic growth in a pure undercooled melt at low undercooling, which can be compared quantitatively with NASA:s space Isothermal Dendritic Growth Experiments (IDGE) on succinonitrile (SCN) and pivalic acid (PVA).
Author
Crystal Growth; Dendritic Crystals; Supercooling; Simulation

20010057274 NASA Glenn 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 Glenn Research Center, USA; Pines, V., NASA Glenn Research Center, USA; Microgravity Materials Science Conference 2000; March 2001; Volume 2, pp. 360-365; In English; See also 20010057256; CD-ROM contains the entire Conference Proceedings presented in PDF format
Contract(s)/Grant(s): NAG8-1488; No Copyright; Avail: CASI; A02, Hardcopy

Dendritic solidification is a common mode of solidification. It is also an important model problem in nonequilibrium physics and pattern formation physics. Current theories couple the transfer of latent heat with selection mechanisms at the interface. Measurements of succinonitrile (SCN) dendrites in microgravity show reasonable agreement between heat transfer predictions and experiment. However, data and analysis for assessing interfacial physics theories are less definitive. We are studying, and will present data on, transient effects in dendritic growth of SCN. We employ the Clapeyron pressure/melting temperature effect to make a rapid change in a sample's hydrostatic pressure, and thereby rapidly change the specimen's melting temperature, forcing the dendrite to select a new steady-state. These initial measurements show some surprising and non-intuitive effects.
Author
Dendritic Crystals; Solidification; Crystal Growth; Microgravity

20010057286 NASA Marshall Space Flight Center, Huntsville, AL USA
CO2 Acquisition Membrane (CAM) Project
Mason, L. W., Lockheed Martin Space Systems Co., USA; Way, J. D., Colorado School of Mines, USA; Vlasse, M., NASA Marshall Space Flight Center, USA; Microgravity Materials Science Conference 2000; March 2001; Volume 2, pp. 411-412; In English; See also 20010057256; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A01, Hardcopy

The CO2 Acquisition Membrane (CAM) project will develop, test, and analyze membrane materials for separation and purification of carbon dioxide (CO2) from mixtures of gases, such as those found in the Martian atmosphere. The CAM technology will enable passive separation of these gases, allow energy efficient acquisition and purification of these important resources, and lay the foundation for future unmanned sample return and human space missions. The CAM membranes are targeted toward In Situ Resource Utilization (ISRU) applications, such as In Situ Propellant Production (ISPP) and In Situ Consumables Production (ISCP).
Author
Carbon Dioxide Removal; Gas Mixtures; Mars (Planet)

20010057292 George Mason Univ., Dept. of Mathmatical Sciences, Fairfax, VA USA
A Phase-Field/Fluid Motion Model of Solidification: Investigation of Flow Effects During Directional Solidification and Dendritic Growth
Anderson, D. M., George Mason Univ., USA; Boettinger, W. J., National Inst. of Standards and Technology, USA; McFadden, G. B., National Inst. of Standards and Technology, USA; Wheeler, A. A., Southampton Univ., UK; Microgravity Materials Science Conference 2000; March 2001; Volume 2, pp. 435-439; In English; See also 20010057256; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A01, Hardcopy

The phase-field model of diffusion-controlled solidification has recently been 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 extended model includes fluid flow by a further coupling to the Navier-Stokes equations. In our work, the solid phase is treated as a fluid 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. This

model is applied to solidification and crystal growth situations in order to investigate the effect of fluid motion in the melt on the growth characteristics.
Author
Crystal Growth; Dendritic Crystals; Directional Solidification (Crystals); Diffusion; Melts (Crystal Growth); Fluid Flow

20010057302 NASA Marshall Space Flight Center, Huntsville, AL USA
Microgravity Materials Science Conference 2000, Volume 3
Ramachandran, Narayanan, Universities Space Research Association, USA; Bennett, Nancy, Universities Space Research Association, USA; McCauley, Dannah, Alabama Univ., USA; Murphy, Karen, Morgan Research Corp., USA; Poindexter, Samantha, Universities Space Research Association, USA; Microgravity Materials Science Conference 2000; March 2001; 244p; In English; 4th; Microgravity Materials Science Conference 2000, 6-8 June 2000, Huntsville, AL, USA; See also 20010057303 through 20010057340; CD-ROM conatins the entire conference proceedings presented in PDF format
Report No.(s): NASA/CP-2001-210827/VOL3; M-1003/VOL3; NONP-NASA-CD-2001082995; NAS 1.55:210827/VOL3; No Copyright; Avail: CASI; C01, CD-ROM; A11, Hardcopy; A03, Microfiche

This is Volume 3 of 3 of the 2000 Microgravity Materials Science Conference that was held June 6-8 at the Von Braun Center, Huntsville, Alabama. It was organized by the Microgravity Materials Science Discipline Working Group, sponsored by the Microgravity Research Division (MRD) at NASA Headquarters, and hosted by NASA Marshall Space Flight Center and the Alliance for Microgravity Materials Science and Applications (AMMSA). It was the fourth NASA conference of this type in the Microgravity materials science discipline. The microgravity science program sponsored ~200 investigators, all of whom made oral or poster presentations at this conference- In addition, posters and exhibits covering NASA microgravity facilities, advanced technology development projects sponsored by the NASA Microgravity Research Division at NASA Headquarters, and commercial interests were exhibited. The purpose of the conference was to inform the materials science community of research opportunities in reduced gravity and to highlight the Spring 2001 release of the NASA Research Announcement (NRA) to solicit proposals for future investigations. It also served to review the current research and activities in material,, science, to discuss the envisioned long-term goals. and to highlight new crosscutting research areas of particular interest to MRD. The conference was aimed at materials science researchers from academia, industry, and government. A workshop on in situ resource utilization (ISRU) was held in conjunction with the conference with the goal of evaluating and prioritizing processing issues in Lunar and Martian type environments. The workshop participation included invited speakers and investigators currently funded in the material science program under the Human Exploration and Development of Space (HEDS) initiative. The conference featured a plenary session every day with an invited speaker that was followed by three parallel breakout sessions in subdisciplines. Attendance was close to 350 people, Posters were available for viewing during the conference and a dedicated poster session was held on the second day. Nanotechnology, radiation shielding materials, Space Station science opportunities, biomaterials research, and outreach and educational aspects of the program were featured in the plenary talks. This volume, the first to be released on CD-ROM for materials science, is comprised of the research reports submitted by the Principal Investigators at the conference.
Author
Conferences; Microgravity Applications; Crystal Growth; Microgravity; Gravitational Effects; Directional Solidification (Crystals)

20010057323 Iowa State Univ. of Science and Technology, Ames Lab., Ames, IA USA
Interface Pattern Selection in Directional Solidification
Trivedi, Rohit, Iowa State Univ. of Science and Technology, USA; Tewari, Surendra N., Cleveland State Univ., USA; Microgravity Materials Science Conference 2000; March 2001; Volume 3, pp. 586-592; In English; See also 20010057302; CD-ROM contains the entire Conference Proceedings presented in PDF format
Contract(s)/Grant(s): NCC8-98; No Copyright; Avail: CASI; A02, Hardcopy

The central focus of this research is to establish key scientific concepts that govern the selection of cellular and dendritic patterns during the directional solidification of alloys. Ground-based studies have established that the conditions under which cellular and dendritic microstructures form are precisely where convection effects are dominant in bulk samples. Thus, experimental data can not be obtained terrestrially under pure diffusive regime. Furthermore, reliable theoretical models are not yet possible which can quantitatively incorporate fluid flow in the pattern selection criterion. Consequently, microgravity experiments on cellular and dendritic growth are designed to obtain benchmark data under diffusive growth conditions that can be quantitatively analyzed and compared with the rigorous theoretical model to establish the fundamental principles that govern the selection of specific microstructure and its length scales. In the cellular structure, different cells in an array are strongly coupled so that the cellular pattern evolution is controlled by complex interactions between thermal diffusion, solute diffusion and interface effects. These interactions give infinity of solutions, and the system selects only a narrow band of solutions. The aim of this

investigation is to obtain benchmark data and develop a rigorous theoretical model that will allow us to quantitatively establish the physics of this selection process.
Author
Interfacial Tension; Crystal Growth; Dendritic Crystals; Directional Solidification (Crystals); Microstructure

20010057324 Iowa State Univ. of Science and Technology, Ames Lab., Ames, IA USA
Dynamical Selection of Three-Dimensional Patterns in Directional Solidification
Trivedi, Rohit, Iowa State Univ. of Science and Technology, USA; Napolitano, Ralph E., Iowa State Univ. of Science and Technology, USA; Karma, Alain S., Northeastern Univ., USA; Microgravity Materials Science Conference 2000; March 2001; Volume 3, pp. 593-598; In English; See also 20010057302; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A02, Hardcopy

I The central focus of this research is to establish fundamental principles that govern the dynamical selection of interface patterns during the directional solidification of model transparent materials. Several ground-based studies on primary cellular/dendritic spacing have clearly established that the primary spacing does not have a unique value under given growth conditions. Rather, the selection of the spacing is governed by the history, and experiments with the same history lead to a reproducible pattern. Thus, the precise understanding of the pattern evolution requires the knowledge of the dynamics of spacing selection. The goal of this research is to quantitatively establish the complete dynamics of interface pattern selection. In addition, the conditions for transitions from planar to cellular and cellular to dendritic structures under dynamical conditions of growth will also be established. In order to obtain benchmark data on the dynamics of pattern formation, a transparent model system will be used in which the time-evolution of the pattern can be continuously imaged and analyzed. These experimental results will be coupled with a detailed modeling of the pattern evolution by using the phase field approach. The benchmark data obtained under microgravity conditions will allow us to validate the model so that a predictive theory of pattern formation can be formulated. This study is in collaboration with French Space Agency (CNES), and we intend to use the DECLIC hardware that is now being built by CNES.
Author
Three Dimensional Models; Directional Solidification (Crystals); Dynamic Characteristics

20010057327 Northwestern Univ., Dept. of Materials Science and Engineering, Evanston, IL USA
Coarsening in Solid-Liquid Mixtures
Alkemper, Jens, Northwestern Univ., USA; Snyder, V. A., Northwestern Univ., USA; Voorhees, Peter W., Northwestern Univ., USA; Microgravity Materials Science Conference 2000; March 2001; Volume 3, pp. 614-618; In English; See also 20010057302; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A01, Hardcopy

The late-stages of a first-order phase transformation process are usually characterized by the growth of second-phase domains with low interfacial curvature at the expense of domains with high interfacial curvature, This process, also known as Ostwald ripening or coarsening, occurs in a wide variety of two-phase mixtures ranging from multiphase solids to multiphase liquids, and has a significant impact on the high temperature stability of many technologically important materials. Unfortunately, an understanding of the dynamics of ripening processes is not in hand. Many of the recent theories for the effects of a finite volume fraction of coarsening phase on the kinetics of Ostwald ripening have proposed divergent expressions for the dependence of the coarsening rate of the system on the volume fraction of coarsening phase. As there are virtually no experimental data of sufficient quality to differentiate between these theories, or even provide qualitative information on the coarsening dynamics of low volume fraction systems, the controversy over the dependence of the coarsening rate of the system on the volume fraction remains unresolved.
Author
Arsenic; Liquid-Solid Interfaces; Phase Transformations; Kinetics

20010057329 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; Microgravity Materials Science Conference 2000; March 2001; Volume 3, pp. 624-629; In English; See also 20010057302; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A02, Hardcopy

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(O2) atmospheres, and avoid heterogeneous nucleation by container

walls to access highly non-equilibrium liquids. Research during the first four years (June 1996-June 2000) included investigation of binary alumina-silica (Al2O3-SiO2) alumina-magnesia Al2O3-MgO), and alumina-yttria (Al2O3-Y2O3)) materials. The major emphasis of the research was on fragile undercooled alumina-yttria melts. These melts exhibit a highly non-Arhennian viscosity vs temperature dependence, large heat capacity relative to the crystalline solid, and a polyamorphic phase transition. A separate Flight Definition project is in progress to perform microgravity experiments that determine the viscosity in this fragile liquid and the mechanism of polyamorphic phase transition. The research on alumina-magnesia melts has for the first time provided pure and homogeneous glass samples of the forsterite. This result is of special interest because forsterite is a member of the very abundant olivine family of minerals. Accomplishments described in this report were to: (1) Investigate liquid-phase processing, undercooling, and solidification of binary alumina-silica, alumina-magnesia, and alumina-yttria materials under non equilibrium conditions; (2) Investigate the temperature dependence of the viscosity of deeply undercooled melts; (3) Measure the structure of YAG- and mullite-composition liquids; (4) Characterize processed materials using optical and scanning electron microscopy and X-ray diffraction analysis; (5) Develop collaborative research activities in the processing of oxide liquids and the characterization of novel products; and (6) Publish and present results.
Author
High Temperature; Liquids; Aluminum Oxides; Magnesium Oxides; Melts (Crystal Growth); Microgravity; Phase Transformations; Silicon Dioxide; Solid Phases

24
COMPOSITE MATERIALS

Includes physical, chemical, and mechanical properties of laminates and other composite materials.

20010054455 NASA Pasadena Office, CA USA
Composite Material Switches
Javadi, Hamid, Inventor, Jet Propulsion Lab., California Inst. of Tech., USA; May 15, 2001; 10p; In English; Division of US-Patent-Appl-SN-530976, filed 20 Sep. 1995
Patent Info.: Filed 20 Jun. 2000; NASA-Case-NPO-19442-2; US-Patent-6,232,866; US-Patent-Appl-SN-606111; US-Patent-Appl-SN-530976; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

A device to protect electronic circuitry from high voltage transients is constructed from a relatively thin piece of conductive composite sandwiched between two conductors so that conduction is through the thickness of the composite piece. The device is based on the discovery that conduction through conductive composite materials in this configuration switches to a high resistance mode when exposed to voltages above a threshold voltage.
Official Gazette of the U.S. Patent and Trademark Office
Composite Materials; Switches; Protection

20010054978 Geo-Centers, Inc., Newton, MA USA
Synthesis and Characterization of Advanced Materials ***Final Report, Aug. 1994-Dec. 2000***
Greenawald, E.; Bailey, W.; Bellinger, E.; Campbell, K.; Ham, Y. S.; Apr. 11, 2001; 74p; In English
Contract(s)/Grant(s): N00014-94-C-2195
Report No.(s): AD-A388787; GC-2801; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

GEO-CENTERS, INC. programs in support of the Naval Research Laboratory Materials Chemistry Branch have addressed the development, characterization, and improvement of a variety of materials of interest to the Navy. A major program was directed to investigations of composite sonar dome structures and materials, dome failures and nondestructive evaluation. Also in support of sonar dome programs, computer database modernization and web site development tasks were accomplished. GEO-CENTERS also conducted research in the area of polymer synthesis and characterization and provided research and documentation support to the Office of naval Research ocean, atmosphere, and space programs.
DTIC
Synthesis (Chemistry); Polymers; Composite Structures

20010055267 NASA Johnson Space Center, Houston, TX USA
Energy Absorbing Protective Shroud
Schneider, William C., Inventor, NASA Johnson Space Center, USA; Mar. 27, 2001; 8p; In English
Patent Info.: Filed 22 Sep. 1998; NASA-Case-MSC-22823-1; US-Patent-6,206,155; US-Patent-Appl-SN-158752; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The present invention is a dissipating protection energy system designed to receive and safely dissipate the kinetic energy from high energy fragments. The energy dissipation system dissipates energy transferred to it by the incremental and progressive rupturing at an approximately constant force of strategically placed sacrificial stitching applied to a number of high strength straps, such as an aromatic polyimide fiber of extremely high tensile strength. Thus, the energy dissipation system provides a lightweight device for controlling and dissipating the dangerous and destructive energy stored in high strength fragments released by catastrophic failures of machinery minimizing damage to other critical components.
Official Gazette of the U.S. Patent and Trademark Office
Protection; Energy Dissipation; Kinetic Energy

20010057081 NASA Langley Research Center, Hampton, VA USA
Structural and Acoustic Numerical Modeling of a Curved Composite Honeycomb Panel
Grosveld, Ferdinand W., Lockheed Martin Engineering and Sciences Co., USA; Buehrle, Ralph D., NASA Langley Research Center, USA; Robinson, Jay H., NASA Langley Research Center, USA; [2001]; 11p; In English; 7th AIAA/CEAS Aeroacoustics Conference, 28-30 May 2001, Maastricth, Netherlands; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Report No.(s): AIAA Paper 2001-2277; Copyright Waived; Avail: CASI; A03, Hardcopy; A01, Microfiche

The finite and boundary element modeling of the curved section of a composite honeycomb aircraft fuselage sidewall was validated for both structural response and acoustic radiation. The curved panel was modeled in the pre-processor MSC/PATRAN. Geometry models of the curved panel were constructed based on the physical dimensions of the test article. Material properties were obtained from the panel manufacturer. Finite element models were developed to predict the modal parameters for free and supported panel boundary conditions up to a frequency of 600 Hz. Free boundary conditions were simulated by providing soft foam support under the four comers of the panel or by suspending the panel from elastic bands. Supported boundary conditions were obtained by clamping the panel between plastic tubing seated in grooves along the perimeter of a stiff and heavy frame. The frame was installed in the transmission loss window of the Structural Acoustic Loads and Transmission (SALT) facility at NASA Langley Research Center. The structural response of the curved panel due to point force excitation was predicted using MSC/NASTRAN and the radiated sound was computed with COMET/Acoustics. The predictions were compared with the results from experimental modal surveys and forced response tests on the fuselage panel. The finite element models were refined and updated to provide optimum comparison with the measured modal data. Excellent agreement was obtained between the numerical and experimental modal data for the free as well as for the supported boundary conditions. Frequency response functions (FRF) were computed relating the input force excitation at one panel location to the surface acceleration response at five panel locations. Frequency response functions were measured at the same locations on the test specimen and were compared with the calculated FRF values. Good agreement was obtained for the real and imaginary parts of the transfer functions when modal participation was allowed up to 3000 Hz. The validated finite element model was used to predict the surface velocities due to the point force excitation. Good agreement was obtained between the spatial characteristics of the predicted and measured surface velocities. The measured velocity data were input into the acoustic boundary element code to compute the sound radiated by the panel. The predicted sound pressure levels in the far-field of the panel agreed well with the sound pressure levels measured at the same location.
Author
Boundary Conditions; Aircraft Structures; Honeycomb Structures; Composite Structures; Curved Panels; Fuselages; Sound Waves

20010057614 California Univ., Dept. of Mechanical and Aerospace Engineering, Los Angeles, CA USA
Effect of Loading Parameters on Fatigue of Composite Laminates, Part 4, Information Systems ***Final Report***
Hahn, H. T.; Turkgenc, O.; Dec. 2000; 84p; In English
Contract(s)/Grant(s): DTFA03-92-A-00003
Report No.(s): PB2001-105074; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

Damage tolerance, damage resistance and durability assessments of aircraft composite structures are essential components of certification. The certification procedure requires lengthy experimental validation of those assessments, although much research has been conducted to understand the behavior of polymer matrix composites under service conditions. A fair amount of data is available together with a number of analytical models in these areas of research. However, because of the vast number of parameters involved, a generic model is rather difficult to develop. The ultimate goal of this study is the identification of design parameters to be used in the development of information system tools that can help engineers synthesize different sets of data efficiently. In the information system developed in the current work for structural behavior with damage, all parameters that have been studied are available for the user to choose as input. The output contains design parameters such as compression strength after impact, dent depth, and damage area as well as literature references, raw data, tables and plots. The information systems is

constituted in a relational database environment and tools from expert system technology are incorporated so that low confidence input can be captured and flexibility can be maintained in similarity assessments. With this system it is also possible to conduct parametric studies to determine the effect of each design parameter or a combination of parameters on the damage behavior. Case examples are included to demonstrate practical uses of the information system for both data retrieval and similarity studies.
NTIS
Damage Assessment; Laminates; Static Loads; Composite Materials; Impact Tests; Composite Structures; Design Analysis; Impact Damage; Information Systems; Fatigue (Materials)

20010058678 NASA Langley Research Center, Hampton, VA USA
High Fidelity Failure Analysis for a Composite Fuselage Section
Li, Jain, Boeing Co., USA; Davila, Carlos G., NASA Langley Research Center, USA; Chen, Tzi-Kang, Army Research Lab., USA; [2001]; 7p; In English; American Helicopter Society 57th Annual Forum, 9-11 May 2001, Washington, DC, USA; Sponsored by American Helicopter Society, Inc., USA; Original contains color illustrations; Copyright; Avail: Issuing Activity

A high fidelity delamination failure analysis was developed by combining a local failure analysis with a global full-scale finite element structural analysis to address strength and delamination failure in a single package. The methodology was demonstrated through a local three-dimensional pull-off failure analysis and a geometrically nonlinear structural analysis of a five-foot composite helicopter fuselage section. Pull-off specimens were used to identify potential debonding failure of co-cured skin-stringer/frame fuselage structures. An investigation of the failed pull-off specimens was performed to determine the location of the failure initiation. Three-dimensional strain energy release rate analysis indicates that the delamination initiation and growth is controlled by Mode 1 opening mode. The bending moment at the delamination tip was identified as the crucial factor controlling the failure. The geometrically nonlinear structural analysis of a five-foot composite fuselage section was performed using a detailed finite element model. Loads were applied along the periphery of the subcomponent using displacement fields generated from solutions of a full-vehicle model.
Author
Delaminating; Failure Analysis; Fuselages; Strain Energy Release Rate; Structural Analysis

20010058878 Los Alamos National Lab., NM USA
Neutron Scattering Techniques as Advanced Structural Probes of Filled and Nanocomposite Elastomers: A Technique for the 21st Century
Hjelm, R. P.; Oct. 26, 2000; 18p; In English; Meeting of the Rubber Division, American Chemical Society, 3-6 Apr. 2000, Dallas, TX, USA
Report No.(s): PB2001-105668; LA-UR-2910; No Copyright; Avail: National Technical Information Service (NTIS)

The last three decades has seen the development of neutron scattering techniques as probes for the nanoscale structure of polymer filled and nanocomposite polymer systems. The objectives of these studies includes understanding filler associations, bound polymer conformation and inter-actions of bound and matrix polymer and the relationship between these and mechanical properties with the goal of determining the mechanism of reinforcement. This information is central to the development of improved composites. Although this goal has not yet been attained, fundamental and unique information has resulted. In this presentation, I review the new information that we have obtained from the elastic neutron scattering probes of nanoscale composite and filler structure. The author discuss the prospects of these techniques in achieving our long-term goals.
NTIS
Composite Structures; Neutron Scattering; Elastic Scattering; Fillers

20010059000 Rensselaer Polytechnic Inst., Troy, NY USA
Micromechanics of Inelastic Composite Materials
Jan. 1998; 29p; In English
Contract(s)/Grant(s): DAAG55-98-1-0464
Report No.(s): AD-A388672; ARO-38324-3.-EG; No Copyright; Avail: CASI; A01, Microfiche; A03, Hardcopy

Under these circumstances, it is essential to develop micromechanical theories which evaluate the local fields and predict the overall response under combined thermal and mechanical loads. The basic elements of these theories are geometrical modeling of the microstructures and local interactions, and constitutive modeling of the homogeneous phases. An essential requirement of the latter is to include inelastic deformation to model composite systems which exhibit nonlinear response under thermal and mechanical service loads. Since the early 1960s, micromechanics of composite materials has attracted many researchers. This led to significant theoretical developments for prediction of elastic and inelastic constitutive response, and motivated experimental validation. The purpose is to summarize these developments, and illustrate their application in predicting the overall response

under thermomechanical loads. Although treatment of the subject in this chapter covers two-phase particulate and fibrous materials, the focus in applications will be on fibrous composites and laminates.
DTIC
Fiber Composites; Micromechanics; Deformation; Elastic Properties; Laminates; Microstructure

20010059024 Army Research Lab., Vehicle Technology Directorate, Hampton, VA USA
Fatigue and Damage Tolerance Analysis of a Hybrid Composite Tapered Flexbeam
Murri, Gretchen B., Army Research Lab., USA; Schaff, Jeffrey R., United Technologies Research Center, USA; Dobyns, Al, Sikorsky Aircraft, USA; [2001]; 54p; In English; American Helicopter Society Forum, 9-11 May 2001, Washington, DC, USA; Sponsored by American Helicopter Society, Inc., USA; Original contains color illustrations; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

The behavior of nonlinear tapered composite flexbeams under combined axial tension and cyclic bending loading was studied using coupon test specimens and finite element (FE) analyses. The flexbeams used a hybrid material system of graphite/epoxy and glass/epoxy and had internal dropped plies, dropped in an overlapping stepwise pattern. Two material configurations, differing only in the use of glass or graphite plies in the continuous plies near the midplane, were studied. Test specimens were cut from a full-size helicopter tail-rotor flexbeam and were tested in a hydraulic load frame under combined constant axialtension load and transverse cyclic bending loads. The first determination damage observed in the specimens occurred at the area around the tip of the outermost ply-drop group in the tapered region of the flexbeam, near the thick end. Delaminations grew slowly and stably, toward the thick end of the flexbeam, at the interfaces above and below the dropped-ply region. A 2D finite element model of the flexbeam was developed. The model was analyzed using a geometrically non-linear analysis with both the ANSYS and ABAQUS FE codes. The global responses of each analysis agreed well with the test results. The ANSYS model was used to calculate strain energy release rates (G) for delaminations initiating at two different ply-ending locations. The results showed that delaminations were more inclined to grow at the locations where they were observed in the test specimens. Both ANSYS and ABAQUS were used to calculate G values associated with delamination initiating at the observed location but growing in different interfaces, either above or below the ply-ending group toward the thick end, or toward the thin end from the tip of the resin pocket. The different analysis codes generated the same trends and comparable peak values, within 5-11 % for each delamination path. Both codes showed that delamination toward the thick region was largely mode II, and toward the thin region was predominantly mode I. The calculated peak G-values from either analysis predict delamination is most likely to occur along the same interface where it was observed in the test specimens. Calculated peak G values were used with material characterization data to calculate a curve relating the fatigue life of the specimens, N, to the applied transverse load, V, for a given constant axial load.
Author
Beams (Supports); Fatigue Life; Damage; Epoxy Matrix Composites; Graphite-Epoxy Composites; Delaminating; Glass Fiber Reinforced Plastics; Hybrid Composites

20010059033 Guigne International Ltd., Paradise, Newfoundland Canada
Combustion Synthesis of Glass-Ceramic Composites Under Terrestrial and Reduced Gravity Conditions
Manerbino, Anthony, Guigne International Ltd., Canada; Yi, H. C., Guigne International Ltd., Canada; Guigne, J. Y., Guigne International Ltd., Canada; Moore, J. J., Colorado School of Mines, USA; Space Technology and Applications International Forum 2000; [2000], pp. 416-422; In English
Contract(s)/Grant(s): RTOP 101-12-0A; Copyright; Avail: Issuing Activity

Glasses based on B2O3-Al2O3-BaO-and B2O3-Al2O3-MgO have been produced by the combustion synthesis technique. The combustion temperature, wave velocity for selected compositions are presented. Combustion reactions of these materials were typically low exothermic, resulting in unstable combustion waves. Microstructural characterization of these materials indicated that the glass formation region was similar to those that were produced by the traditional technique. Results of the effect of gravity on the glass formation (or divitrification) studied onboard of KC-135 is also presented.
Author
Combustion Synthesis; Glass; Combustion Temperature; Flame Propagation; Ceramic Matrix Composites; Aluminum Oxides

20010059205 NASA Langley Research Center, Hampton, VA USA
A {1,2}-Order Plate Theory Accounting for Three-Dimensional Thermoelastic Deformations in Thick Composite and Sandwich Laminates
Tessler, A., NASA Langley Research Center, USA; Annett, M. S., Orbital Sciences Corp., USA; Gendron, G., Laval Univ., Canada; Composite Structures; 2001; ISSN 0263-8223; Volume 52, pp. 67-84; In English; Copyright; Avail: Issuing Activity

A {1,2}-order theory for laminated composite and sandwich plates is extended to include thermoelastic effects. The theory incorporates all three-dimensional strains and stresses. Mixed-field assumptions are introduced which include linear in-plane displacements, parabolic transverse displacement and shear strains, and a cubic distribution of the transverse normal stress. Least squares strain compatibility conditions and exact traction boundary conditions are enforced to yield higher polynomial degree distributions for the transverse shear strains and transverse normal stress through the plate thickness. The principle of virtual work is used to derive a 10th-order system of equilibrium equations and associated Poisson boundary conditions. The predictive capability of the theory is demonstrated using a closed-form analytic solution for a simply-supported rectangular plate subjected to a linearly varying temperature field across the thickness. Several thin and moderately thick laminated composite and sandwich plates are analyzed. Numerical comparisons are made with corresponding solutions of the first-order shear deformation theory and three-dimensional elasticity theory. These results, which closely approximate the three-dimensional elasticity solutions, demonstrate that through - the - thickness deformations even in relatively thin and, especially in thick. composite and sandwich laminates can be significant under severe thermal gradients. The {1,2}-order kinematic assumptions insure an overall accurate theory that is in general superior and, in some cases, equivalent to the first-order theory.
Author
Three Dimensional Models; Analysis (Mathematics); Composite Structures; Deformation; Elastic Properties; Plate Theory; Prediction Analysis Techniques

20010059297 Colorado School of Mines, Center for Commercial Applications of Combustion in Space, Golden, CO USA
Gravitational Effects on Combustion Synthesis of Advanced Porous Materials
Zhang, X., Colorado School of Mines, USA; Moore, J. J., Colorado School of Mines, USA; Schowengerdt, F. D., Colorado School of Mines, USA; Thorne, K., Sulzer Orthopedics Biologics, Inc., USA; Apr. 01, 2000; 8p; In English; 12th International Proceedings of the Experimental Methods for Microgravity Materials Science ASM International, 1 Apr. 2000, USA; Sponsored in part by Colorado Advanced Technology Institute and by Sulzer Medica, CO
Contract(s)/Grant(s): NCC3-659; RTOP 101-12-0A; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Combustion Synthesis (self-Propagating high-temperature synthesis-(SHS)) of porous Ti-TiB(x), composite materials has been studied with respect to the sensitivity to the SHS reaction parameters of stoichiometry, green density, gasifying agents, ambient pressure, diluents and gravity. The main objective of this research program is to engineer the required porosity and mechanical properties into the composite materials to meet the requirements of a consumer, such as for the application of bone replacement materials. Gravity serves to restrict the gas expansion and the liquid movement during SHS reaction. As a result, gravitational forces affect the microstructure and properties of the SHS products. Reacting these SHS systems in low gravity in the KC-135 aircraft has extended the ability to form porous products. This paper will emphasize the effects of gravity (low g, 1g and 2g) on the SHS reaction process, and the microstructure and properties of the porous composite. Some of biomedical results are also discussed.
Author
Combustion Synthesis; Composite Materials; Gravitational Effects; Microgravity; Porous Materials; Bioastronautics; Porosity; Titanium

20010059322 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA USA
Electrical Impedance of Ionic Polymeric Metal Composites
Leary, S., Jet Propulsion Lab., California Inst. of Tech., USA; Bar-Cohen, Y., Jet Propulsion Lab., California Inst. of Tech., USA; [1999]; 6p; In English; Proceedings of SPIE's 6th Annual International Symposium on Smart Structures and Materials, 1-5 Mar. 1999, San Diego, CA, USA; Sponsored by International Society for Optical Engineering, USA; Copyright; Avail: Issuing Activity

In recent years the use of ionic polymer metal composites such as Nafion-based platinum ionomers have emerged as electroactive polymer materials with great potential for robotics and other applications. An effective activation of these materials requires understanding of their mechanism of operation. Generally, the material needs to be maintained hydrated to assure its electromechanical activity. to allow the control of the response of the material, a study is underway to investigate the electrical response. Particular emphasis is placed on possible electrochemical reactions and deviations from linear dielectric behavior. Currently, efforts are made to determine the necessary drive characteristics of the source to allow low power operation (is less than or = 1.0 W) of the material as an actuator.
Author
Electrical Impedance; Metals; Electroactive Polymers; Composite Materials

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INORGANIC, ORGANIC AND PHYSICAL CHEMISTRY

Includes the analysis, synthesis, and use inorganic and organic compounds; combustion theory; electrochemistry; and photochemistry. For related information see also 34 Fluid Dynamics and Thermodynamics, For astrochemistry see category 90 Astrophysics.

20010054613 Princeton Univ., NJ USA
Vapor Bubble Luminescence From Deep Sea Hydrothermal Vent Minerals and Other Hot Solids
Reynolds, G. T., Princeton Univ., USA; Mar. 30, 2001; 10p; In English
Contract(s)/Grant(s): N00014-00-1-0010
Report No.(s): AD-A388838; No Copyright; Avail: CASI; A01, Microfiche; A02, Hardcopy

Vapor bubble luminescence, first notice when a jet of superheated steam enters cold water, has been observed when certain hot solids, 300 C, are dropped into room temperature water. The materials observed include several deep sea hydrothermal vent minerals, basalt, iron, and copper.
DTIC
Luminescence; Minerals; Solids; Bubbles; Vapors

20010054975 Army Research Lab., Sensors Directorate, Adelphi, MD USA
Investigation of Anomalous n-Type Behavior in LWIR MBE-Grown Hg(1-x)Cd(x)Te Using Secondary Ion Mass Spectrometry (SIMS), *Oct. 1998-Sep. 1999*
Boyd, P. R.; Lee, U.; Almeida, L. A.; Benson, J. D.; Mar. 2001; 18p; In English; Original contains color plates
Contract(s)/Grant(s): Proj-A31B
Report No.(s): AD-A388908; ARL-TR-701; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Residual impurities and process-introduced electrically active impurities have long been a source of producibility- and performance-related limitations in Hg(1-x)Cd(x)Te materials and devices. Considerable effort has been expended to reduce the impurity content of II-VI substrate materials and to control the level of both donor and acceptor impurities in thin-film sensing layers. In an effort to develop the next major breakthrough in Hg(1-x)Cd(x)Te materials and device technology, the Communications-Electronics Command (CECOM) Night Vision and Electronic Sensors Directorate (NVESD) has been working on a novel technology tool called the NVESD ”microfactory”. This MBE-based (molecular beam epitaxy) materials growth and device-fabrication tool is designed to allow for epitaxial materials growth, device fabrication, and passivation processes to be completed in situ in the vacuum system. However, controlled intentional doping of these layers has been hampered by high n-type background carrier concentrations in some of the layers after the mercury vacancy anneal. In this work we analyzed a number of MBE Hg(1-x)Cd(x)Te layers, bulk Cd(1-y)Zn(y)Te, and CdTe substrates using secondary ion mass spectrometry (SIMS) to qualitatively determine the major species responsible for the high n-type behavior and their possible sources.
DTIC
Mercury Cadmium Tellurides; Molecular Beam Epitaxy; Secondary Ion Mass Spectrometry; Anomalies

20010055583 FROM
Transient Application, Recirculating Pool Fire, Agent Effectiveness Screen: Final Report, NGP Project 3A/2/890
Grosshandler, W.; Hamins, A.; McGrattan, K.; Presser, C.; Apr. 2001; 96p
Report No.(s): PB2001-104791; NISTIR-6733; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

Because of its many positive attributes, halon 1301, or trifluorobromomethane (CF3Br), has been used as a fire extinguishing agent in many applications including aircraft, ships, and specialized structures. Due to its high ozone depletion potential, however, world-wide production was halted in 1994. In the search for a long-range replacement, novel types of extinguishing agents and delivery mechanisms are under development. to gauge the suitability of a replacement agent, methods are needed to evaluate the material’s suppression effectiveness under conditions that relate to field applications. In this study, a laboratory-scale facility has been developed to screen the suppression effectiveness of agents that are delivered in a transient fashion such as solid propellant gas generators. The transient application, recirculating pool fire (TARPF) agent effectiveness screen features a propane fire stabilized behind an obstruction, which is known to be a highly challenging suppression configuration. The character of the flame and the impact of the air flow, fuel flow, obstruction geometry, and rate of agent addition on the amount of material needed for suppression are evaluated for N2, CF3 Br, and a solid propellant gas generator (SPGG).
NTIS
Fire Extinguishers; Replacing

20010056273 NASA Marshall Space Flight Center, Huntsville, AL USA

IEC Research Status at MSFC

Hrbud, Ivana, NASA Marshall Space Flight Center, USA; Dobson, Chris, NASA Marshall Space Flight Center, USA; [2001]; 4p; In English; Inertial Electrostatic Confinement Workshop, 22-23 Mar. 2001, Huntsville, AL, USA; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

This viewgraph presentation gives an overview of the Inertial Electrostatic Confinement (IEC) research status at Marshall Space Flight Center. Details are given on the experiment setup (hardware characteristics, diagnostic equipment, propellant feed system, and planned pulse mode operation), grid manufacturing (identified manufacturing techniques, such as metal deposition, negative template mold, and machining), and grid for IEC operation (negative template technique and electrochemical technique). CASI

Confinement; Electrostatics; Experiment Design

20010056289 NASA Kennedy Space Center, Cocoa Beach, FL USA

Evaluating Mass Analyzers as Candidates for Small, Portable, Rugged Single Point Mass Spectrometers for Analysis of Permanent Gases

Arkin, C. Richard, DYNACS Engineering Co., Inc., USA; Ottens, Andrew K., Florida Univ., USA; Diaz, Jorge A., Costa Rica Univ., Costa Rica; Griffin, Timothy P., DYNACS Engineering Co., Inc., USA; Follestein, Duke, NASA Kennedy Space Center, USA; Adams, Fredrick, NASA Kennedy Space Center, USA; [2001]; 2p; In English; ASMS Conference, 28-31 May 2001, Chicago, IL, USA; Sponsored by ASMS, USA

Contract(s)/Grant(s): NAS10-98001; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

For Space Shuttle launch safety, there is a need to monitor the concentration of H2, He, O2, and Ar around the launch vehicle. Currently a large mass spectrometry system performs this task, using long transport lines to draw in samples. There is great interest in replacing this stationary system with several miniature, portable, rugged mass spectrometers which act as point sensors which can be placed at the sampling point. Five commercial and two non-commercial analyzers are evaluated. The five commercial systems include the Leybold Inficon XPR-2 linear quadrupole, the Stanford Research (SRS-100) linear quadrupole, the Ferran linear quadrupole array, the ThermoQuest Polaris-Q quadrupole ion trap, and the IonWerks Time-of-Flight (TOF). The non-commercial systems include a compact double focusing sector (CDFMS) developed at the University of Minnesota, and a quadrupole ion trap (UF-IT) developed at the University of Florida.

Derived from text

Mass Spectrometers; Gas Analysis; Monitors; Sampling; Miniaturization

20010056316 NASA Kennedy Space Center, Cocoa Beach, FL USA

A Quadrupole Ion Trap Mass Spectrometer for Quantitative Analysis of Nitrogen-Purged Compartments within the Space Shuttle

Ottens, Andrew K., Florida Univ., USA; Griffin, Timothy P., DYNACS Engineering Co., Inc., USA; Helms, William R., NASA Kennedy Space Center, USA; Yost, Richard A., Florida Univ., USA; [2001]; 2p; In English; ASMS Conference, 28-31 May 2001, Chicago, IL, USA; Sponsored by ASMS, USA

Contract(s)/Grant(s): NAS10-98001; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

To enter orbit, the Space Shuttle burns 1.8 million liters of liquid hydrogen combined with 0.8 million liters of liquid oxygen through three rocket engines mounted in the aft. NASA monitors the nitrogen-purged aft compartment for increased levels of hydrogen or oxygen in order to detect and determine the severity of a cryogenic fuel leak. Current monitoring is accomplished with a group of mass spectrometer systems located as much as 400 feet away from the Shuttle. It can take up to 45 seconds for gas to reach the mass spectrometer, which precludes monitoring for leaks in the final moments before liftoff (the orbiter engines are started at T-00:06 seconds). to remedy the situation, NASA is developing a small rugged mass spectrometer to be used as point-sensors around the Space Shuttle. As part of this project, numerous mass analyzer technologies are being investigated. Presented here are the preliminary results for one such technology, quadrupole ion trap mass spectrometry (QITMS). A compact QITMS system has been developed in-house at the University of Florida for monitoring trace levels of four primary gases, hydrogen, helium, oxygen, and argon, all in a nitrogen background. Since commercially available QITMS systems are incapable of mass analysis at m/z(exp 2), the home-built system is preferred for the evaluation of QITMS technology.

Derived from text

Mass Spectrometers; Monitors; Leakage

20010056405 California Univ., Dept. of Chemistry, Davis, CA USA

Development of a Time of Flight Mass Spectrometry Method for the Screening of Polycyclic Aromatic Hydrocarbons and Nitro-Substituted Polycyclic Aromatic Hydrocarbons ***Final Report***

Suro, J.; Chen, Q.; Kelly, P. B.; Apr. 2000; 60p; In English

Report No.(s): PB2001-104854; ARB-R-97/305; No Copyright; Avail: CASI; A01, Microfiche; A04, Hardcopy

Laser Desorption Ionization Time of Flight Mass Spectrometry LDI/TOFMS has been developed for the direct screening of polycyclic aromatic hydrocarbons (PAHs) and nitrosubstituted polycyclic aromatic hydrocarbons (nitro-PAHs). An ultraviolet 266-nm laser desorbs and ionizes PAHs and nitro-PAHs from the filter support material. The ions are mass analyzed in a custom built time of flight mass spectrometer. The laser power dependence of ionization and fragmentation of positive ions for the PAH compounds listed in ARB method 429 has been examined. The negative ion yield of nitro-PAH that was targeted by the MLD source test method has also been systematically examined for fragmentation and ionization efficiency. The fragmentation/ionization studies show that there is a range of power densities that can produce molecular ion without significant fragmentation of the parent molecule for all but three of the compounds listed in Method 429. Naphthalene, acenaphthalene and acenapthene have relatively high vapor pressures.

NTIS

Time of Flight Spectrometers; Environmental Monitoring; Polycyclic Aromatic Hydrocarbons; Mass Spectroscopy

20010057219 Illinois Univ., Dept. of Chemical Engineering, Chicago, IL USA

Combustion Synthesis of Materials in Microgravity

Brezinsky, K., Illinois Univ., USA; Microgravity Materials Science Conference 2000; March 2001; Volume 1, pp. 113-114; In English; See also 20010057199; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A01, Hardcopy

Transition metal nitrides have become increasingly attractive for their distinctive thermodynamic, mechanical, electrical, magnetic and superconducting characteristics; the high degree of melting temperature, hardness, electrical resistivity and magnetic susceptibility are comparable to the corresponding transition metals. In particular, nitrides of the group IV metals in the periodic table, including titanium, represent higher melting temperatures and chemical stability than those of the transition metals in other groups, mainly due to the unique bonding structure between the solid metal and nonmetal components. Accordingly, a detailed experimental study of the self-propagating high-temperature synthesis (SHS) of titanium nitride was conducted to improve the conversion yield and illustrate the mechanism of formation of this representative transition metal nitride. Further investigations are currently under way to apply and build upon the same techniques used for the synthesis of titanium nitride in the SHS of other transition metal nitrides, such as molybdenum nitride and niobium nitride, as well as several carbides produced in solid-solid SHS. The conditions of the titanium nitride investigation were atmospheric pressure, room temperature and normal-gravity in a fluidized bed of gaseous nitrogen (99.995%) and solid, spherical titanium particles of approximately 50 microns in diameter. Several parameters, such as the strength of the random motion of the fluidized particles, particle size, thermodynamic properties of the fluid and thermodynamic properties of the circulating particles were proven to cause considerable variance in the ignition characteristics of the fluidized bed. For the fluidized bed combustion system, a homogenous dispersion of the titanium particles in the freeboard was necessary. A nitrogen-purged, dual-syringe particle injection system was devised to aid in creating the desired particle distribution and facilitate ignition, Figure 1. The titanium particles were successfully ignited to attain a high conversion yield at the atmospheric pressure condition. This is in contrast to previous investigations in which high-pressure conditions were utilized to aid in ignition and increase the conversion yield. From this atmospheric system, a maximum conversion yield for the combustion synthesis of titanium nitride of approximately 60% was obtained at a feed rate to the freeboard of 27.0 g/min, Figure 2. The yield decreases from its maximum with both a decrease and increase in feeding rates. The highest conversion yield was ascribed to increased nitrogen accessibility to the precursor particle surface by increasing the interstitial distances between particles in the fluidization to an optimal distance under these conditions.

Author

Combustion Synthesis; Microgravity; Transition Metals; Superconductivity; Magnetic Permeability; Thermodynamic Properties

20010057317 Arizona Univ., Dept. of Aerospace and Mechanical Engineering, Tucson, AZ USA

The Effect of Doping on the Ion Conductivity and Biaxial Flexural Strength of YSZ Solid Oxide Electrolyzers

Sridhar, K. R., Arizona Univ., USA; Chen, Weinong, Arizona Univ., USA; Microgravity Materials Science Conference 2000; March 2001; Volume 3, pp. 551-555; In English; See also 20010057302; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A01, Hardcopy

Solid oxide electrolyzers generate pure oxygen from oxygen bearing gases such as carbon dioxide, water, and air. Such 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 will reduce the cost of both robotic and human missions with the added advantage of risk reduction. Space exploration missions call 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.
Author
Performance Tests; Oxygen Production; Electrical Properties; Crack Initiation; Additives; Ion Currents

20010057322 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; Backov, Renal, Florida Univ., USA; Adair, James H., Pennsylvania State Univ., USA; Microgravity Materials Science Conference 2000; March 2001; Volume 3, pp. 580-584; In English; See also 20010057302; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A01, Hardcopy

Materials with directional properties are opening new horizons in a variety of applications including chemistry, electronics, and optics. 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. The new applications and the need for model particles in scientific investigations are rapidly outdistancing the ability to synthesize anisotropic particles with specific chemistries and narrowly distributed physical characteristics (e.g. size distribution, shape, and aspect ratio). While there has been considerable progress 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. Amphiphilic molecules can be used to prepare either ”water-in-oil” or ”oil-in-water” micelles, and these organic ”template” structures have been used to control the size of growing inorganic particles. Larger concentrations of the segregated phase leads to the formation of bilayer structures. In our laboratories, we have demonstrated that these anisotropic micellular structures can be used as templates to prepare anisotropic particles in both metallic and inorganic salt systems. This project aims to extend the methods that have been developed to other inorganic particle systems and to increase our level of understanding of how anisotropic particles are formed at lamellar templates.
Author
Anisotropy; Ceramics; Isotropy; Microgravity; Microstructure; Powder (Particles)

20010057584 NASA Glenn Research Center, Cleveland, OH USA
Effects of Evaporation/Condensation on Spreading and Contact Angle of a Volatile Liquid Drop
Zhang, Nengli, Ohio Aerospace Inst., USA; Chao, David F., NASA Glenn Research Center, USA; [2000]; 6p; In English; 5th International Symposium on Heat Transfer, 12-16 Aug. 2000, Beijing, China
Contract(s)/Grant(s): NCC3-620; RTOP 101-13-0A; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Effects of evaporation/condensation on spreading and contact angle were experimentally studied. A sessile drop of R-113 was tested at different vapor environments to determine the effects of evaporation/condensation on the evolution of contact diameter and contact angle of the drop. Condensation on the drop surface occurs at both the saturated and a nonsaturated vapor environments and promotes the spreading. When the drop is placed in the saturated vapor environment it tends to completely wetting and spreads rapidly. In a nonsaturated vapor environment, the evolution of the sessile drop is divided three stages: condensation-spreading stage, evaporation-retracting stage and rapid contracting stage. In the first stage the drop behaves as in the saturated environment. In the evaporation -retracting stage, the competition between spreading and evaporation of the drop determines the evolution characteristics of the contact diameter and the contact angle. A lower evaporation rate struggles against the spreading power to turn the drop from spreading to retracting with a continuous increase of the contact angle. The drop placed in open air has a much higher evaporation rate. The strong evaporation suppresses the spreading and accelerates the retraction of the drop with a linear decrease of the contact diameter. The contraction of the evaporating drops is gradually accelerated when the contact diameter decreases to 3 min and less till drying up, though the evaporation rate is gradually slowing down.
Author
Evaporation; Spreading; Drops (Liquids); Condensing; Angles (Geometry)

20010058679 Washington Univ., Dept. of Mechanical Engineering, Saint Louis, MO USA

Gas-Phase Combustion Synthesis of Aluminum Nitride Powder

Axelbaum, R. L., Washington Univ., USA; Lottes, C. R., Washington Univ., USA; Huertas, J. I., Washington Univ., USA; Rosen, L. J., Washington Univ., USA; [1996], pp. 1891-1897; In English; Twenty-Sixth International Symposium on Combustion, 1996, Unknown; Sponsored by Combustion Inst., USA; Sponsored in part by Lowy Fellowship

Contract(s)/Grant(s): NAG3-1910; RTOP 101-12-00; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Due to its combined properties of high electrical resistivity and high thermal conductivity aluminum nitride (AlN) is a highly desirable material for electronics applications. Methods are being sought for synthesis of unagglomerated, nanometer-sized powders of this material, prepared in such a way that they can be consolidated into solid compacts having minimal oxygen content. A procedure for synthesizing these powders through gas-phase combustion is described. This novel approach involves reacting AlCl3, NH3, and Na vapors. Equilibrium thermodynamic calculations show that 100% yields can be obtained for these reactants with the products being AlN, NaCl, and H2. The NaCl by-product is used to coat the AlN particles in situ. The coating allows for control of AlN agglomeration and protects the powders from hydrolysis during post-flame handling. On the basis of thermodynamic and kinetic considerations, two different approaches were employed to produce the powder, in co-flow diffusion flame configurations. In the first approach, the three reactants were supplied in separate streams. In the second, the AlCl3 and NH3 were premixed with HCl and then reacted with Na vapor. X-ray diffraction (XRD) spectra of as-produced powders show only NaCl for the first case and NaCl and AlN for the second. After annealing at 775 C tinder dynamic vacuum, the salt was removed and XRD spectra of powders from both approaches show only AlN. Aluminum metal was also produced in the co-flow flame by reacting AlCl3 with Na. XRD spectra of as-produced powders show the products to be only NaCl and elemental aluminum.

Author

Aluminum Nitrides; Combustion Synthesis; Vapor Phases; X Ray Diffraction; Thermal Conductivity; Electrical Resistivity; Powder (Particles)

20010059189 California Univ., Dept. of Physics, Berkeley, CA USA

Fast Growth Method of Computing Free Energy Differences

Hendrix, D. A.; Jarzynski, C.; 2001; 26p; In English

Report No.(s): PB2001-105643; LA-UR-00-2050; No Copyright; Avail: National Technical Information Service (NTIS)

Let delta F be the free energy difference between two equilibrium states of a system. An established method of numerically computing delta F involves a single, long switching simulation, during which the system is driven reversibly from one state to the other (slow growth, oradiabatic switching). Here we study a method of obtaining the same result from numerous independent, irreversible simulations of much shorter duration (fast growth). We illustrate the fast growth method, computing the excess chemical potential of a Lennard-Jones fluid as a test case, and we examine the performance of fast growth as a practical computational tool.

NTIS

Free Energy; Comparison

20010059238 NASA Glenn Research Center, Cleveland, OH USA

Rhenium/Oxygen Interactions at Elevated Temperatures

Jacobson, Nathan, NASA Glenn Research Center, USA; Myers, Dwight, East Central Univ., USA; Zhu, Dong-Ming, Ohio Aerospace Inst., USA; Humphrey, Donald, DYNACS Engineering Co., Inc., USA; [2000]; 15p; In English

Contract(s)/Grant(s): RTOP 708-90-13; No Copyright; Avail: CASI; A01, Microfiche; A03, Hardcopy

The oxidation of pure rhenium is examined from 600-1400 C in oxygen/argon mixtures. Linear weight loss kinetics are observed. Gas pressures, flow rates, and temperatures are methodically varied to determine the rate controlling steps. The reaction at 600 and 800 C appears to be controlled by a chemical reaction step at the surface; whereas the higher temperature reactions appear to be controlled by gas phase diffusion of oxygen to the rhenium surface. Attack of the rhenium appears to be along grain boundaries and crystallographic planes.

Author

Chemical Reactions; High Temperature; Rhenium; Oxygen; Gas Pressure; Gas Mixtures; Kinetics

20010059242 Washington Univ., Dept. of Mechanical Engineering, Saint Louis, MO USA

The Effects of Flame Structure on Extinction of CH4-O2-N2 Diffusion Flames

Du, J., Washington Univ., USA; Axelbaum, R. L., Washington Univ., USA; 1996; 6p; In English; Twenty-Sixth International Symposium on Combustion, 1996, Unknown

Contract(s)/Grant(s): NAG3-1910; RTOP 101-12-00; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The effects of flame structure on the extinction limits of CH4-O2-N2 counterflow diffusion flames were investigated experimentally and numerically by varying the stoichiometric mixture fraction Z(sub st), Z(sub st) was varied by varying free-stream concentrations, while the adiabatic flame temperature T(sub ad) was held fixed by maintaining a fixed amount of nitrogen at the flame. Z(sub st) was varied between 0.055 (methane-air flame) and 0.78 (diluted- methane-oxygen flame). The experimental results yielded an extinction strain rate K(sub ext) of 375/s for the methane-air flame, increasing monotonically to 1042/s for the diluted-methane-oxygen flame. Numerical results with a 58-step Cl mechanism yielded 494/s and 1488/s, respectively. The increase in K(sub ext) with Z(sub st) for a fixed T(sub ad) is explained by the shift in the O2 profile toward the region of maximum temperature and the subsequent increase in rates for chain-branching reactions. The flame temperature at extinction reached a minimum at Z(sub st) = 0.65, where it was 200 C lower than that of the methane-air flame. This significant increase in resistance to extinction is seen to correspond to the condition in which the OH and O production zones are centered on the location of maximum temperature.
Author
Diffusion Flames; Flame Temperature; Chain Reactions (Chemistry); Nitrogen; Oxygen; Methane

20010059243 Northwestern Univ., Robert R. McCormick School of Engineering and Applied Science, Evanston, IL USA
Scale-Invariant Forms of Conservation Equations in Reactive Fields and a Modified Hydro-Thermo-Diffusive Theory of Laminar Flames
Sohrab, Siavash H., Northwestern Univ., USA; [2000]; 15p; In English; International Workshop on Unsteady Combustion and Interior Ballistics, 24-30 Jun. 2000, Saint Petersburg, Russia; Sponsored by NASA Glenn Research Center, USA
Contract(s)/Grant(s): NAG3-1863; RTOP 101-12-OA; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
A scale-invariant model of statistical mechanics is applied to present invariant forms of mass, energy, linear, and angular momentum conservation equations in reactive fields. The resulting conservation equations at molecular-dynamic scale are solved by the method of large activation energy asymptotics to describe the hydro-thermo-diffusive structure of laminar premixed flames. The predicted temperature and velocity profiles are in agreement with the observations. Also, with realistic physico-chemical properties and chemical-kinetic parameters for a single-step overall combustion of stoichiometric methane-air premixed flame, the laminar flame propagation velocity of 42.1 cm/s is calculated in agreement with the experimental value.
Author
Flame Propagation; Laminar Flow; Statistical Mechanics; Scale Models; Conservation Equations; Molecular Dynamics; Physical Chemistry; Activation Energy

20010059296 Academy of Sciences (Russia), Inst. of Structural Macrokinetics and Materials Science, Chernogolovka, Russia
Diffusion Driven Combustion Waves in Porous Media
Aldushin, A. P., Academy of Sciences (Russia), Russia; Matkowsky, B. J., Northwestern Univ., USA; Combustion Science and Technology; 2000; Volume 156, pp. 221-250; In English
Contract(s)/Grant(s): NAG3-2209; NSF DMS-97-05670; Copyright; Avail: Issuing Activity
Filtration of gas containing oxidizer, to the reaction zone in a porous medium, due, e.g., to a buoyancy force or to an external pressure gradient, leads to the propagation of Filtration combustion (FC) waves. The exothermic reaction occurs between the fuel component of the solid matrix and the oxidizer. In this paper, we analyze the ability of a reaction wave to propagate in a porous medium without the aid of filtration. We find that one possible mechanism of propagation is that the wave is driven by diffusion of oxidizer from the environment. The solution of the combustion problem describing diffusion driven waves is similar to the solution of the Stefan problem describing the propagation of phase transition waves, in that the temperature on the interface between the burned and unburned regions is constant, the combustion wave is described by a similarity solution which is a function of the similarity variable x/square root of(t) and the wave velocity decays as 1/square root of(t). The difference between the two problems is that in the combustion problem the temperature is not prescribed, but rather, is determined as part of the solution. We will show that the length of samples in which such self-sustained combustion waves can occur, must exceed a critical value which strongly depends on the combustion temperature T(sub b). Smaller values of T(sub b) require longer sample lengths for diffusion driven combustion waves to exist. Because of their relatively small velocity, diffusion driven waves are considered to be relevant for the case of low heat losses, which occur for large diameter samples or in microgravity conditions, Another possible mechanism of porous medium combustion describes waves which propagate by consuming the oxidizer initially stored in the pores of the sample. This occurs for abnormally high pressure and gas density. In this case, uniformly propagating planar waves, which are kinetically controlled, can propagate, Diffusion of oxidizer decreases the wave velocity. In addition to the reaction and diffusion layers, the uniformly propagating wave structure includes a layer with a pressure gradient, where the gas motion is induced by

the production or consumption of the gas in the reaction as well as by thermal expansion of the gas. The width of this zone determines the scale of the combustion wave in the porous medium.
Author
Diffusion Waves; Porosity; Thermal Expansion; Wave Propagation; Gas Expansion; Combustion Temperature; Compressed Gas

20010059376 NASA Glenn Research Center, Cleveland, OH USA
Upward Flame Spread Over Thin Solids in Partial Gravity
Feier, I. I., Case Western Reserve Univ., USA; Shih, H. Y., Case Western Reserve Univ., USA; Sacksteder, K. R., NASA Glenn Research Center, USA; Tien, J. S., NASA Glenn Research Center, USA; [2001]; 16p; In English; 39th Aerospace Sciences Meeting and Exhibit, 8-11 Jan. 2001, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA; Original contains color illustrations
Report No.(s): AIAA Paper 2001-0466; Copyright Waived; Avail: CASI; A03, Hardcopy; A01, Microfiche

The effects of partial-gravity, reduced pressure, and sample width on upward flame spread over a thin cellulose fuel were studied experimentally and the results were compared to a numerical flame spread simulation. Fuel samples 1-cm, 2-cm, and 4-cm wide were burned in air at reduced pressures of 0.2 to 0.4 atmospheres in simulated gravity environments of 0.1-G, 0.16-G (Lunar), and 0.38-G (Martian) onboard the NASA KC-135 aircraft and in normal-gravity tests. Observed steady flame propagation speeds and pyrolysis lengths were approximately proportional to the gravity level. Flames spread more quickly and were longer with the wider samples and the variations with gravity and pressure increased with sample width. A numerical simulation of upward flame spread was developed including three-dimensional Navier-Stokes equations, one-step Arrhenius kinetics for the gas phase flame and for the solid surface decomposition, and a fuel-surface radiative loss. The model provides detailed structure of flame temperatures, the flow field interactions with the flame, and the solid fuel mass disappearance. The simulation agrees with experimental flame spread rates and their dependence on gravity level but predicts a wider flammable region than found by experiment. Some unique three-dimensional flame features are demonstrated in the model results.
Author
Flame Propagation; Flammability; Gravitational Effects; Flames; Computerized Simulation

20010059603 Hawaii Univ., Dept. of Mechanical Engineering, Honolulu, HI USA
Triaxial Burke-Schumann Flames with Applications to Flame Synthesis
Chao, B. H., Hawaii Univ., USA; Axelbaum, R. L., Washington Univ., USA; Combustion Science and Technology; 2000; Volume 156, pp. 291-314; In English
Contract(s)/Grant(s): NAG3-1910; NAG3-1912; Copyright; Avail: Issuing Activity

The problem of a flame generated by three coaxial flows is solved by extending the Burke-Schumann methodology to include a third stream. The solution is particularly relevant to flame synthesis wherein multiple tubes are often employed either to introduce inert as a diffusion barrier or to introduce more than two reactants. The general problem is solved where the inner and outer tubes contain reactants and the middle tube contains either an inert or a third reactant. Relevant examples are considered and the results show that the triaxial Burke-Schumann flame can be substantially more complicated than the traditional Burke-Schumann flame. When the middle flow is inert the flame temperature is no longer constant but increases axially, reaching a maximum at the flame centerline. At the exit the flame does not sit on the tube exit but instead resides between the inner and outer tubes, resulting in an effective barrier for particle build-up on the burner rim. For the case of a third reactant in the middle flow, synthesis chemistry where the inner reaction is endothermic and the outer reaction is exothermic is considered. In addition to showing the flame temperature and flame shape, the results identify conditions wherein reaction is not possible due to insufficient heat transfer from the outer flame to support the inner flame reaction.
Author
Flame Temperature; Flames; Synthesis (Chemistry); Coaxial Flow; Endothermic Reactions; Exothermic Reactions; Burners

20010059605 NASA Glenn Research Center, Cleveland, OH USA
Rhenium-Oxygen Interactions at High Temperatures
Jacobson, Nathan S., NASA Glenn Research Center, USA; Myers, Dwight L., East Central Univ., USA; Zhu, Dongming, Ohio Aerospace Inst., USA; Humphrey, Donald, DYNACS Engineering Co., Inc., USA; [2000]; 4p; In English; 10th International IUPAC Conference on High Temperature Materials Chemistry, 10-14 Apr. 2000, Julich, Germany; Sponsored by International Union of Pure and Applied Chemistry, Unknown
Contract(s)/Grant(s): RTOP 523-90-43; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

The reaction of pure rhenium metal with dilute oxygen/argon mixtures was studied from 600 to 1400 C. Temperature, oxygen pressure, and flow rates were systematically varied to determine the rate-controlling steps. At lower temperatures the

oxygen/rhenium chemical reaction is rate limiting; at higher temperatures gas-phase diffusion of oxygen through the static boundary layer is rate limiting. At all temperatures post-reaction microstructures indicate preferential attack along certain crystallographic planes and defects.
Author
Chemical Reactions; Gas Mixtures; Oxygen; Rhenium; High Temperature

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METALS AND METALLIC MATERIALS

Includes physical, chemical, and mechanical properties of metals and metallic materials; and metallurgy.

20010054788 NASA Langley Research Center, Hampton, VA USA
Method and Apparatus to Access Optimum Strength During Processing of Precipitation Strengthened Alloys
Cantrell, John H., Inventor, NASA Langley Research Center, USA; Yost, William T., Inventor, NASA Langley Research Center, USA; Mar. 06, 2001; 10p; In English; Provisonal application US-Patent-Appl-SN-050915, filed 24 Apr. 1997
Patent Info.: Filed 24 Apr. 1998; NASA-Case-LAR-15562-1; US-Patent-6,197,130; US-Patent-Appl-SN-065986; US-Patent-Appl-SN-050915; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

A method and apparatus are provided which enable the nondestructive testing of strength of a heat treated alloy. An alloy is insonified with an ultrasonic signal. The resulting convoluted signal is detected and the acoustic nonlinearity parameter is determined. The acoustic nonlinearity parameter shows a peak corresponding to a peak in material strength.
Official Gazette of the U.S. Patent and Trademark Office
Precipitation Hardening; Heat Treatment; Nondestructive Tests

20010056683 NASA Glenn Research Center, Cleveland, OH USA
Effects of Space Environment on Flow and Concentration During Directional Solidification
Benjapiyaporn, C., New South Wales Univ., Australia; Timchenko, V., New South Wales Univ., Australia; Leonardi, E., New South Wales Univ., Australia; deVahlDavis, G., New South Wales Univ., Australia; deGroh, H. C., III, NASA Glenn Research Center, USA; April 2000; 28p; In English; Sponsored in part by Australian Dept. of Industry, Science and Technology
Contract(s)/Grant(s): RTOP 101-43-0B
Report No.(s): NASA/TM-2000-209293; E-11767; NAS 1.15:209293; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A study of directional solidification of a weak binary alloy (specifically, Bi - 1 at% Sn) based on the fixed grid single domain approach is being undertaken. The enthalpy method is used to solve for the temperature field over the computational domain including both the solid and liquid phases; latent heat evolution is treated with the aid of an effective specific heat coefficient. A source term accounting for the release of solute into the liquid during solidification has been incorporated into the solute transport equation. The vorticity-stream function formulation is used to describe thermosolutal convection in the liquid region. In this paper we numerically investigate the effects of g-jitter on directional solidification. A background gravity of 1 micro-g has been assumed, and new results for the effects of periodic disturbances over a range of amplitudes and frequencies on solute field and segregation have been presented.
Author
Gravitation; Aerospace Environments; Directional Solidification (Crystals); Vorticity; Solid Phases; Binary Alloys

20010056684 NASA Glenn Research Center, Cleveland, OH USA
The Effect of Heat Treatment on Residual Stress and Machining Distortions in Advanced Nickel Base Disk Alloys
Gayda, John, NASA Glenn Research Center, USA; January 2001; 54p; In English; Original contains color illustrations
Contract(s)/Grant(s): RTOP 714-04-10
Report No.(s): NASA/TM-2001-210717; E-12670; NAS 1.15:210717; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

This paper describes an extension of NASA's AST and IDPAT Programs which sought to predict the effect of stabilization heat treatments on residual stress and subsequent machining distortions in the advanced disk alloy, ME-209. Simple "pancake" forgings of ME-209 were produced and given four heat treats: 2075F(SUBSOLVUS)/OIL QUENCH/NO AGE; 2075F/OIL QUENCH/1400F@8HR;2075F/OIL QUENCH/1550F@3HR/l400F@8HR; and 2160F(SUPERSOLVUS)/OIL QUENCH/1550F@3HR/ 1400F@8HR. The forgings were then measured to obtain surface profiles in the heat treated condition. A simple machining plan consisting of face cuts from the top surface followed by measurements of the surface profile opposite

the cut were made. This data provided warpage maps which were compared with analytical results. The analysis followed the IDPAT methodology and utilized a 2-D axisymmetric, viscoplastic FEA code. The analytical results accurately tracked the experimental data for each of the four heat treatments. The 1550F stabilization heat treatment was found to significantly reduce residual stresses and subsequent machining distortions for fine grain (subsolvus) ME209, while coarse grain (supersolvus) ME209 would require additional time or higher stabilization temperatures to attain the same degree of stress relief.
Author
Residual Stress; Heat Resistant Alloys; Nickel Alloys; Temperature Effects

20010057203 Northwestern Univ., Dept. of Materials Science and Engineering, Evanston, IL USA
The Evolution of Dendrite Morphology During Isothermal Coarsening
Alkemper, Jens, Northwestern Univ., USA; Voorhees, Peter, Northwestern Univ., USA; Microgravity Materials Science Conference 2000; March 2001; Volume 1, pp. 24-26; In English; See also 20010057199; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A01, Hardcopy

The project studies the evolution of dendrites during isothermal coarsening for Sn-dendrites in a Pb-Sn matrix phase. The matrix is liquid during the coarsening process to ensure significant coarsening in a reasonable amount of time. This system has been chosen because it has been extensively studied in the past with respect to coarsening, particularly in the Coarsening in Solid-Liquid Mixtures (CSLM) project. The process of dendrite coarsening is crucial to all casting processes where dendrites are formed in the early stage of the cooling process. All dendrites subsequently coarsen until the structure is completely solidified. In order to study the effect of the coarsening process on the overall microstructure it is useful to design the experiments so that the coarsening happens isolated from the overall solidification but still involves a dendritic microstructure. Once the coarsening of dendrites has been studied it can be fed back into the understanding and simulation of casting processes. The results thus will provide new insights into dendritic coarsening as well as guide simulations of solidification processing with respect to coarsening.
Derived from text
Morphology; Isothermal Processes; Coarseness; Dendritic Crystals; Microstructure

20010057205 Florida Univ., Dept. of Chemical Engineering, Gainesville, FL USA
An Electrochemical Method for Measuring Convection and Diffusion in Liquid Metals
Anderson, Timothy J., Florida Univ., USA; Narayanan, Ranga, Florida Univ., USA; Crunkleton, Daniel W., Florida Univ., USA; Serrano, Brenda, Florida Univ., USA; Pankajavalli, R., Indira Gandhi Centre for Atomic Research, India; Microgravity Materials Science Conference 2000; March 2001; Volume 1, pp. 33-38; In English; See also 20010057199; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A02, Hardcopy

The final goal of this research is to establish the liquid-state, self-diffusivity temperature dependence D(T) for selected elements. This requires data sets of sufficient accuracy such that a clear statistical correlation can be drawn between these data and the (existing) theories. At the present time, the scatter in the data sets is too large to make any reliable prediction of the best fit. In order to obtain the most reliable correlations diffusivities will be determined over the majority of the elements' liquid range (up to 14000 C). We will then interpret the measured self-diffusivity data in terms of diffusion mechanisms and associated liquid structures. With increasing 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. In particular, there is little insight into the temperature dependence of diffusivities and its correlation to the temperature-dependent liquid structure of an element. Currently, the differences between several theoretical predictions are often less than those between different sets of data for the same system. Hence, for both theoretical and technological developments, there is a clear need for diffusivity measurements of improved accuracy and precision for a large variety of elements over wide temperature ranges.
Derived from text
Electrochemistry; Convection; Diffusion; Liquid Metals; Diffusivity; Temperature Dependence

20010057206 Alabama Univ., Dept. of Materials and Mechanical Engineering, Birmingham, AL USA
Wetting Characteristics of Immiscibles
Andrews, J. B., Alabama Univ., USA; Microgravity Materials Science Conference 2000; March 2001; Volume 1, pp. 39-44; In English; See also 20010057199; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A02, Hardcopy

Binary immiscible alloys form two separated liquids on melting that exist over a temperature and composition range. Many desirable characteristics and applications have been proposed for these alloys. For example, some immiscible alloys show promise for use in medical applications, including use as filters for submicron particulates. Other alloys are expected to exhibit Type II

superconductivity or high coercive magnetic field strengths. In order to obtain these desirable characteristics, it is necessary to prevent the normal segregation problems that hinder the ability to form desired microstructures in immiscible alloy systems,. The most common segregation mechanism in immiscible alloys is gravity-driven sedimentation. This difficulty usually occurs during normal ground based processing in an attempt to from a dispersed microstructure. microgravity processing should provide a solution to this problem. However, segregation has been observed in low gravity processed immiscible alloys. There are obviously some critically important, but less studied, factors that influence segregation during microgravity processing. These factors, include the interfacial energies between the phases, alloy/ampoule reactions, droplet migration due to gradients in surface tension brought about by temperature and compositional inhomogeneities, the relative volume fractions of the immiscible phases, and alloy/ampoule wetting characteristics.
Author
Wetting; Binary Alloys; Solubility

20010057207 Alabama Univ., Birmingham, AL USA
Coupled Growth in Hypermonotectics
Andrews, J. Barry, Alabama Univ., USA; Coriell, Sam R., National Inst. of Standards and Technology, USA; Microgravity Materials Science Conference 2000; March 2001; Volume 1, pp. 45-51; In English; See also 20010057199; CD-ROM contains the entire Conference Proceedings presented in PDF format
Contract(s)/Grant(s): NAS8-99059; No Copyright; Avail: CASI; A02, Hardcopy

The overall objective of this project is to obtain a fundamental understanding of the physics controlling solidification processes in immiscible alloy systems. The investigation involves both experimentation and the development of a model describing solidification in monotectic systems. The experimental segment was designed to first demonstrate that it is possible to obtain interface stability and steady state coupled growth in hypermonotectic alloys through microgravity processing. Microgravity results obtained to date have verified this possibility. Future flights will permit experimental determination of the limits of interface stability and the influence of alloy composition and growth rate on microstructure. The objectives of the modeling segment of the investigation include prediction of the limits of interface stability, modeling of convective flow due to residual acceleration, and the influence of surface tension driven flows at the solidification interface. The study of solidification processes in immiscible alloy systems is hindered by the inherent convective flow that occurs on Earth and by the possibility of sedimentation of the higher density immiscible liquid phase. It has been shown that processing using a high thermal gradient and a low growth rate can lead to a stable macroscopically planar growth front even in hypermonotectic alloys. Processing under these growth conditions can avoid constitutional supercooling and prevent the formation of the minor immiscible liquid phase in advance of the solidification front. However, the solute depleted boundary layer that forms in advance of the solidification front is almost always less dense than the liquid away from the solidification front. As a result, convective instability is expected. Ground based testing has indicated that convection is a major problem in these alloy systems and leads to gross compositional variations along the sample and difficulties maintaining interface stability. Sustained low gravity processing conditions are necessary in order to minimize these problems and obtain solidification conditions which approach steady state.
Author
Monotectic Alloys; Solidification; Solubility; Solutes; Microstructure

20010057211 Alabama Univ., Center for Microgravity and Materials Research, Huntsville, AL USA
Thermophysical Property Measurements of Te-BASED II-VI Semiconductor Compounds
Banish, R. Michael, Alabama Univ., USA; Pourpoint, Timotheee, Alabama Univ., USA; Alexander, J. Iwan D., Case Western Reserve Univ., USA; Microgravity Materials Science Conference 2000; March 2001; Volume 1, pp. 70-75; In English; See also 20010057199; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A02, Hardcopy

The goal of this research project is to measure the thermal and mass diffusivities of the pure binary tellurium based II-VI semiconductors, i.e., CdTe, ZnTe and, HgTe, and various alloys. For the mass diffusivity determinations, in addition, the diffusivity of various, electrically active impurities, will be determined. Finally, the melting point expansion of these compounds will be determined. Buoyancy-driven convective effects often contaminate the experimental determination of transport properties such as diffusivities and conductivities. The accurate determination of transport properties requires that convective flow velocities be eliminated or significantly suppressed to a few percent of the characteristic velocity. This is generally not possible under terrestrial conditions. Solutally-driven convective contributions can be sustained by much smaller (relatively) gradients than is necessary for thermal nonuniformities only. 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, may 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 a low-gravity environment. However, by comparison with ground-based experiments, the most recently reported low-gravity data using a shear-cell technique appear rather inaccurate. Author

Thermophysical Properties; Tellurium; Semiconductors (Materials); Thermal Diffusion; Mass

20010057215 Michigan State Univ., Dept. of Mechanical Engineering, East Lansing, MI USA

Experimental and Numerical Investigation of Solidification Processes With Convection

Benard, A., Michigan State Univ., USA; Diaz, A. R., Michigan State Univ., USA; Koochesfahani, M. M., Michigan State Univ., USA; McGrath, J. J., Michigan State Univ., USA; Microgravity Materials Science Conference 2000; March 2001; Volume 1, pp. 92-96; In English; See also 20010057199; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A01, Hardcopy

Transport phenomena in microgravity and their influence on the microstructure of alloys during solidification have been studied by a number of researchers using either carefully crafted experiments or numerical computations. Novel experimental and numerical methods are applied in this work to study solidification processes in order to produce an improved fundamental understanding of solidification processes, including the role played by buoyancy-driven convection phenomena in determining the microstructure. A brief overview of our new program and the expected results are provided below. The experimental work consists first of making quantitative measurements of the velocity field, and subsequently temperature field, during the solidification of an optically transparent analog of a binary metallic alloy. A novel Molecular Tagging Velocimetry (MTV) technique is used to perform the velocity field measurements. Attempts will also be made to combine MTV with Laser-Induced Fluorescence (LIF) in order to perform simultaneous temperature and velocity measurements, Such quantitative measurements during the solidification process will enhance our understanding of the diverse transport phenomena occurring during solidification and permit the refinement of the phenomenological models used in averaged transport equations. The experimental data will be compared with the results of solving the averaged governing equations. The objectives of the numerical research are to use a fictitious domain approach to solve averaged governing equations describing the overall solidification process. The use of this method will reduce the time required to generate models by eliminating the need for cumbersome mesh generation. The method is also highly efficient for large problems. The model will be tested against the experimental data, as they become available, and improved as needed. In the following, a brief description of the numerical and experimental aspects of this work is provided.

Author

Solidification; Numerical Analysis; Convection; Microgravity; Transport Properties

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Dynamic Reduction of Multicomponent, Transition-Metal-Cation-Bearing Ceramic Melts and Their Internal Crystalline Nucleation

Everman, Rebecca L. A., Wisconsin Univ., USA; Cooper, Reid F., Wisconsin Univ., USA; Microgravity Materials Science Conference 2000; March 2001; Volume 1, pp. 135-140; In English; See also 20010057199; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A02, Hardcopy

Melts that contain multiple cations can be forced to undergo a dynamic reduction reaction, given appropriate control of the activity of oxygen of the process environment. In the case where a transition metal oxide component is a constituent of the melt, such that the melt becomes a small-polaron-type semiconductor, the reaction dynamic can produce a uniform distribution of metal-either as fine crystals or as fine, discrete droplets, depending on the temperature-within the melt. (The metal that is produced is the one having the smallest, i.e., least negative, (Delta)Gdeg of oxidation.) These metal precipitates, which should prove distinctly resistant to coarsening, can subsequently serve as substrates for the heterogeneous nucleation of crystalline oxides during cooling of the reacted liquid. For a p-type oxide melt, the kinetics of the reduction reaction involves (1) the ablation of O(2-) from the surface (via acceptance of electron holes-2h*-from the melt; i.e., O(2-) + 2h* = 1/2(O2(g)) at the free surface), (2) the diffusion of cations from the free surface inward, charge-compensated by a counterflux of h and (3) reaction at an internal front in which metal is produced by the acceptance of electrons (i.e., the creation of h*) from the component transition-metal cation(s). The dynamic is seen as a ”mirror image” of that for the internal oxidation of alloys. We have pursued experiments on dynamic reduction of a synthetic Fe(2+)-bearing magnesium aluminosilicate melt. Experimental conditions included temperatures approx. 1400 C and an oxygen activity of 10(exp 13), controlled dynamically by flowing CO:CO2. The experiments are designed to precipitate crystalline iron from the melt. The reaction morphology seen includes the formation of distinctly faceted Fe crystals

on the free surface, at a scale -5microns, and internal precipitates of iron at a scale of approx. 10-40 nm. In addition, the precipitation of Fe affects the polymerization (molecular structure) of the remaining aluminosilicate melt and, with it, physical properties such as the viscosity.
Author
Transition Metals; Cations; Metal Oxides; Surface Diffusion; Semiconductors (Materials)

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Sedimentation and Macrosegregation in Quiescent Melting and Liquid Phase Sintering
Courtney, T. H., Michigan Technological Univ., USA; Du, Y., Michigan Technological Univ., USA; Lu, S. Z., Michigan Technological Univ., USA; Microgravity Materials Science Conference 2000; March 2001; Volume 1, pp. 141-148; In English; See also 20010057199; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A02, Hardcopy

There are several existing explanations for the cause for the solid-phase sedimentation often observed during liquid phase sintering (LPS). An alternative cause - macrosegregation during melting and long-range liquid concentration gradients accompanying this segregation - is offered here. Macrosegregation during LPS (or melting) can arise if the densities of the alloy components differ. For example, in melting if the higher-melting component is not present in amounts sufficient to develop an interconnected structure, this component can sink (assuming it is more dense than the liquid) to the crucible bottom. This produces a liquid head consisting of (to a first approximation) the pure lower-melting component. The segregation takes considerable time to eliminate as it exists over a macroscopic distance (the initial particle-settling distance). Similar considerations apply to LPS. Elimination of macrosegregation proceeds in stages. Following initial settling, the liquid in the liquid-plus-solid zone formed by the settling attains its equilibrium composition. Elimination of the long-range liquid concentration gradient takes place subsequently. The tendencies for macrosegregation and the structural evolution in melted/sintered materials can be summarized in a melting map which has axes of alloy and alloy liquidus compositions. Estimated times for the various melting stages can be placed on such a map. The scenario described here is supported by experimental studies of LPS in Pb-Sn alloys.
Author
Liquid Phase Sintering; Sediments; Melting

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Adaptive-Grid Methods for Phase Field Models of Microstructure Development
Dantzig, Jonathan A., Illinois Univ. at Urbana-Champaign, USA; Goldenfeld, Nigel, Illinois Univ. at Urbana-Champaign, USA; Microgravity Materials Science Conference 2000; March 2001; Volume 1, pp. 150-156; In English; See also 20010057199; CD-ROM contains the entire Conference Proceedings presented in PDF format
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Modeling solidification microstructures has become an area of intense study in recent years. The properties of large scale cast products, ranging from automobile engine blocks to aircraft components and other industrial applications, are strongly dependent on the physics that occur at the mesoscopic and microscopic length scales during solidification. The predominant morphology found in solidification microstructures is the dendrite, a tree-like pattern of solid around which solidification proceeds. The microscopic properties of cast products are determined by the length scales of these dendrites, and their associated segregation profiles. For this reason understanding the mechanisms for pattern selection in dendritic growth has attracted a great deal of interest from the experimental and theoretical communities. In particular, a great deal of research has been undertaken to understand such issues as dendrite morphology, shape and growth speed. Experiments on dendrite evolution in pure materials by Glicksman and coworkers on succinonitrile (SCN), and more recently pivalic acid (PVA), as well as other transparent analogs of metals, have provided tests of theories for dendritic growth, and have stimulated considerable theoretical progress. These experiments have clearly demonstrated that in certain parameter ranges the physics of the dendrite tip can be characterized by a steady value for the dendrite tip velocity, radius of curvature and shape. Away from the tip, the time-dependent dendrite exhibits a characteristic sidebranching as it propagates, which is not yet well understood. These experiments are performed by observing individual dendrites growing into an undercooled melt. The experiments are characterized by the dimensionless undercooling. Most experiments are performed at low undercooling.
Author
Dendritic Crystals; Crystal Growth; Solidification; Computerized Simulation

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High Temperature Phases and Phase Equilibria in Reactive Molten Metal-Based Systems

Dreizen, E. L., New Jersey Inst. of Tech., USA; Microgravity Materials Science Conference 2000; March 2001; Volume 1, pp. 182-187; In English; See also 20010057199; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A02, Hardcopy

Recently, the high-temperature portions of metal-gas phase diagrams (specifically, Al-O, Mg-O, Cu-O, Zr-O-N, Ti-O-N, B-C, and B-O) have been used to interpret previously poorly understood metal combustion processes such as explosions of burning metal particles and brightness jumps observed in burning metal particle streaks. It was recognized that phase transitions occurring in molten metal-gas systems could be the causes of these dramatic changes in the metal combustion scenario. The composition and phase changes in these analyzed particles correlated with the observed combustion behavior. However, most of these phase transitions are not well characterized, and the basis on which they are proposed is the elemental analysis of partially burned and rapidly quenched metal particles. This new research is aimed at exploring and characterizing some of these phase changes and, more generally, at addressing high-temperature phase equilibria in reactive, molten, metal-based systems. Specific hypotheses in need of experimental test will be discussed for two particular systems of interest in this program.
Author

Metal-Gas Systems; Phase Transformations; Phase Diagrams; Gas-Metal Interactions; Combustion Physics

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The Role of Convection and Growth Competition in Phase Selection in Microgravity: Controlled Convection in the Containerless Processing of Steel Alloys

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Containerless processing using electromagnetic levitation (EML) is a powerful technique in the investigation of reactive molten metal systems. On ground, the power required to overcome the weight of the sample is sufficient to cause significant heating and induce substantial melt convection. In microgravity, the heating and positioning fields may be decoupled and the field strength may be varied to achieve the desired level of convection within the limits set by the geometry of the levitation coil and the sample size. From high-speed digital images of the double recalescence behavior of Fe-Cr-Ni alloys in ground-based testing and in reduced-gravity aboard the NASA KC-135 parabolic aircraft, we have shown that phase selection can be predicted based on a growth competition model. An important parameter in this model is the delay time between primary nucleation and subsequent nucleation of the stable solid within the liquid/metastable solid array. This delay time is a strong function of composition and a weak function of the undercooling of the melt below the metastable liquidus. From the results obtained during the first Microgravity Sciences Laboratory (MSL-1) mission, we also know that convection may significantly influence the delay time, especially at low undercoolings. Currently, it is unclear what mechanism controls the formation of a heterogeneous site that allows nucleation of the austenitic phase on the pre-existing ferrite skeleton. by examining the behavior of the delay time under different convective conditions, we hypothesize that we can differentiate between several of these mechanisms to gain an understanding of how to control microstructural. evolution. We will anchor these predictions by examining samples quenched at different times following primary recalescence in microgravity. A second important parameter in the growth competition model is the identification of the growth rate of the stable phase into the semi-solid array that formed during primary recalescence. Current dendritic growth theory is inadequate in predicting solidification behavior under these conditions as metallographic analyses show that stable phase growth proceeds along the interface between the metastable solid and residual liquid. Since growth velocity is independent of the initial undercooling relative to the metastable liquidus, we hypothesize that purely thermal effects can be separated from other important growth model parameters by careful selection of the liquid composition in a ternary system.
Author

Convection; Crystal Growth; Dendritic Crystals; Melts (Crystal Growth); Metallography; Microgravity; Nucleation; Space Processing; Steels; Temperature Effects

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Growth of Rod Eutectics

Jackson, Kenneth A., Arizona Univ., USA; Microgravity Materials Science Conference 2000; March 2001; Volume 2, pp. 322; In English; See also 20010057256; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

This study, which has just been funded, will have two components: one will be an in-situ microscopic study of rod eutectic growth in facet/facet and facet/non-facet eutectic systems using transparent organic materials. The second part of the study will be the Monte Carlo modeling of the growth of facet/facet and facet/non-facet eutectic systems. The goal of the experimental study will be to observe the interface and the resulting microstructures for various growth conditions, growth rates, and compositions. This will permit direct comparison of the microstructures with those found in semiconductor-metal systems, and will provide insights into how these microstructures develop. The phenomenology of these alloys is rich, and the in-situ studies will help to define the conditions for the growth of unicorn coupled rod eutectic microstructures.
Author
Eutectics; Microstructure; Rods

20010057266 Purdue Univ., School of Materials Engineering, West Lafayette, IN USA
Experimental and Numerical Investigations of Growth Morphologies of Peritectic Reactions
Johnson, David R., Purdue Univ., USA; Krane, Matthew John M., Purdue Univ., USA; Microgravity Materials Science Conference 2000; March 2001; Volume 2, pp. 325-331; In English; See also 20010057256; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A02, Hardcopy

Coupled growth in a number of peritectic alloys has recently been reported. At compositions less than (but near) the peritectic composition, peritectic alloys generally form a coarse two-phase microstructure when processed under low G/V conditions (G = thermal gradient, V = interface velocity) and banded microstructures for high G/V values. However, at intermediate values, both lamellar and rod-like coupled microstructures have been observed with a much finer interphase spacing then would be expected from cellular or dendritic growth. The goal of this research is to explain the morphological development of two-phase peritectic alloys by coupled experimental and numerical procedures.
Author
Crystal Growth; Morphology; Microstructure; Alloys

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Role of Dynamic Nucleation at Moving Boundaries in Phase and Microstructure Selection
Karma, Alain, Northeastern Univ., USA; Trivedi, Rohit, Iowa State Univ. of Science and Technology, USA; Microgravity Materials Science Conference 2000; March 2001; Volume 2, pp. 345; In English; See also 20010057256; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

We report the results of a combined experimental and theoretical investigation of microstructure formation in directionally solidified (Pb-Bi and Sn-Ca) peritectic alloys. This study focuses on a growth regime of large thermal gradient to pulling speed (G/V) ratio where both the primary and secondary solid phases are morphologically stable. In this regime, the richness of possible microstructures results from the competition between the growth and nucleation of the two solid phases, which turns out to be strongly influenced by convection. Experiments were based on a Bridgman set up where thin diameter tubes of different diameters could be simultaneously solidified. This set up was key to examine the critical influence of varying levels of radial convection on the microstructure. In one set of experiments, convection was enhanced by mechanical stirring. Theoretical studies were based on numerical simulations of sharp interface models that assume a planar solidification front, but incorporate both diffusive and convective transport, and a phase-field model that relaxes this assumption but only incorporates diffusive transport. The critical parameters that were varied in both experiments and simulations include the tube diameter, the composition, and the G/V ratio. In very thin diameter tubes, we were able to obtain banded structures formed by alternate nucleation and growth of the primary and secondary phases. Compositional analysis of the solidified samples revealed that nucleation of the parent and secondary phases do indeed occur above and below the peritectic temperature, respectively, thereby directly validating the basic concept and predictions of the diffusive growth model. Quantitative comparison of experimental data and the model predictions allowed us to extract the values of the nucleation undercoolings for the two phases. For larger tube diameter, careful serial sectioning revealed the existence of a single tree-like structure that is formed by the continuous growth of the two phases with only initial nucleation. The existence of this structure is predicted by numerical simulations with diffusive and convective transport. Phase-field model simulations predict the formation of a particulate banded structure in large samples with multiple nucleation events and purely diffusive growth conditions.
Author
Microstructure; Nucleation; Solid Phases

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Studies of Nucleation, Growth, Specific Heat, and Viscosity of Undercooled Melts of Quasicrystals and Polytetrahedral-Phase-Forming Alloys

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Undercooling experiments and thermal physical property measurements of metallic alloys on the International Space Station (ISS) are planned. This recently-funded research focuses on fundamental issues of the formation and structure of highly-ordered non-crystallographic phases (quasicrystals) and related crystal phases (crystal approximants), and the connections between the atomic structures of these phases and those of liquids and glasses. It extends studies made previously by us of the composition dependence of crystal nucleation processes in silicate and metallic glasses, to the case of nucleation from the liquid phase. Motivating results from rf-levitation and drop-tube measurements of the undercooling of Ti/Zr-based liquids that form quasicrystals and crystal approximants are discussed. Preliminary measurements by electrostatic levitation (ESL) are presented. Author

Nucleation; Specific Heat; Viscosity; Melts (Crystal Growth); Supercooling; Alloys

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Diffusion Processes in Molten Semiconductors

Matthiesen, D. H., Case Western Reserve Univ., USA; Kaforey, M. L., Case Western Reserve Univ., USA; Keefer, L. A., Case Western Reserve Univ., USA; Microgravity Materials Science Conference 2000; March 2001; Volume 2, pp. 413-418; In English; See also 20010057256; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A02, Hardcopy

The DPIMS project has concentrated on Phase 1, which flew on the MSL-1R (STS-94) spacelab mission in June, 1997. The Phase 1 objectives are to provide purely diffusive experimental measurements of the isothermal diffusion coefficients of Ga, Sb and Ga/Si dopants in molten germanium with sufficient accuracy and precision to: a) Differentiate between model predictions of the temperature dependence; b) Determine the effect of dopant size and type; c) Determine if a ”wall effect” is present; d) Provide input to continuum and atomistic model development; and e) Provide a preliminary evaluation of dopant-dopant interactions. Another objective is to develop a 2-dimensional, fully time dependent continuum numerical model of the germanium diffusion column, shear cell, cartridge and furnace for both earth-based and space-based experiments which accurately predicts the measured concentration profile as a function of distance in the diffusion column. A final objective is to develop atomistic models which accurately predict: a) the purely diffusive isothermal diffusion coefficient of a dopant in a molten semiconductor; b) the temperature dependence of the dopants in molten semiconductors; c) attempts to explain the ”wall effect”; and d) develops new empirical potentials useful for predicting other diffusion and transport properties for other molten semiconductor systems. Author

Semiconductors (Materials); Diffusion; Spacelab; Mathematical Models; Diffusion Coefficient; Simulation; Continuum Modeling; Spaceborne Experiments

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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; Microgravity Materials Science Conference 2000; March 2001; Volume 2, pp. 471-476; In English; See also 20010057256; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A02, Hardcopy

The research is within a Flight definition Program, so our efforts have been directed to establishing the science base for directional solidification in low gravity environment. The primary purpose of this research is to compare the microstructure and segregation in a binary metallic 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 diffusional transports of both heat and solute. Important features of the models are the prediction of primary dendrite spacings and dendrite tip radii. However, the thermosolutal convection of liquid in, from, or close to the solid plus liquid region 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. With terrestrial experiments, however, diffusive and convective phenomena occur simultaneously, which complicates the study of dendritic growth. Here we report some of the results from our terrestrial directional solidification experiments.
Author
Directional Solidification (Crystals); Dendritic Crystals; Crystal Growth; Binary Alloys; Microgravity; Space Processing; Cast Alloys; Crystal Structure

20010057305 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA USA
Measurements of Thermophysical Properties of Molten Silicon and Geranium
Rhim, Won-Kyu, Jet Propulsion Lab., California Inst. of Tech., USA; Microgravity Materials Science Conference 2000; March 2001; Volume 3, pp. 493-498; In English; See also 20010057302; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A02, Hardcopy

The objective of this ground base program is to measure thermophysical properties of molten/ undercooled silicon, germanium, and Si-Ge alloys using a high temperature electrostatic levitator and in clearly assessing the need of the microgravity environment to achieve the objective with higher degrees of accuracy. Silicon and germanium are two of the most important semiconductors for industrial applications: silicon is unsurpassed as a microelectronics material, occupying more than 95% of the electronics market. Si-Ge alloy is attracting keen interest for advanced electronic and optoelectronic applications in view of its variable band gap and lattice parameter depending upon its composition. Accurate thermophysical properties of these materials are very much needed in the semiconductor industry for the growth of large high quality crystals.
Author
Thermophysical Properties; Silicon; Germanium; Crystals; Alloys; Levitation; Semiconductors (Materials); Microgravity; Measuring Instruments

20010057313 National Inst. of Standards and Technology, Metallurgy Div., Gaithersburg, MD USA
Thermophysical Properties of High Temperature Liquid Metals and Alloys
Schaefer, Robert J., National Inst. of Standards and Technology, USA; Krishnan, Shankar, Containerless Research, Inc., USA; Boboridis, Konstantinos, National Inst. of Standards and Technology, USA; Microgravity Materials Science Conference 2000; March 2001; Volume 3, pp. 531-532; In English; See also 20010057302; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A01, Hardcopy

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 technique will yield data on selected thermophysical properties with unsurpassed accuracy that can be used in support of microgravity materials science research. The properties measured include enthalpy. specific heat capacity, heat of fusion. and electrical resistivity up to and above the melting point of selected refractory metals and alloys. The key accomplishment of this research is that the laser polarimeter system has been applied to microsecond pulse heating studies and absolute true temperature measurements have been obtained to provide the basis for accurate thermophysical property measurements in the liquid state.
Author
Thermophysical Properties; Liquid Metals; Alloys; High Temperature; Temperature Measurement; Polarimetry; Pulse Heating; Refractory Metals

20010057332 Clarkson Univ., International Center for Gravity, Materials Science and Applications, Potsdam, NY USA
Use of Microgravity to Control the Microstructure of Eutectics
Regel, Liya L., Clarkson Univ., USA; Wilcox, William R., Clarkson Univ., USA; Popov, Dmitri, Clarkson Univ., USA; Li, Fengcui, Clarkson Univ., USA; Ramanathan, Ram, Clarkson Univ., USA; Microgravity Materials Science Conference 2000; March 2001; Volume 3, pp. 643-647; In English; See also 20010057302; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A01, Hardcopy

Directional solidification of eutectics in microgravity has frequently yielded changes in microstructure, particularly with fibrous eutectics. Changes in microstructure have also been observed in some experiments performed on Earth in which the convection in the melt was altered. The causes for these changes are unclear, but worthy of investigation because microstructure determines the utility of these materials. Previous theoretical work at Clarkson University showed that buoyancy-driven convection alone should not influence eutectic microstructure. It was assumed that the composition of the melt was at the eutectic, both in the bulk and at the freezing interface. Consequently, for the present project it was hypothesized that convection alters the microstructure indirectly by causing freezing rate fluctuations. Combined with unequal kinetics of fiber termination and

nucleation, such fluctuations would coarsen the microstructure of some systems, make it finer for some, and have negligible influence on others. In order to test this hypothesis, experimental and theoretical modeling studies were undertaken. Originally, we had planned to perform experiments on Mir in collaboration with Professor Reginald Smith of Queens University in Canada. Although flight ampoules were prepared and ground-based tests performed, difficulties with Mir forced us to abandon these.
Derived from text
Microstructure; Microgravity; Eutectics; Gravitational Effects; Directional Solidification (Crystals); Melts (Crystal Growth)

20010057338 NASA Glenn Research Center, Cleveland, OH USA
Interfacial Surgery Determination of Succinonitrile and Succinonitrile-Acetone Alloy Using Surface Light Scattering Spectrometer
Tin, Padetha, National Center for Microgravity Research on Fluids and Combusiton, USA; Frate, David T., NASA Glenn Research Center, USA; deGroh, Henry C., III, NASA Glenn Research Center, USA; Microgravity Materials Science Conference 2000; March 2001; Volume 3, pp. 585; In English; See also 20010057302; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: Issuing Activity; Abstract Only

The objectives of this ground based research is to measure the liquid/vapor interfacial surface energies of succinonitrile (SCN) and alloys of succinonitrile and acetone using Surface Light Scattering Spectrometer. Liquid/vapor interfacial energy measurements will be made near and above the melting point and are the primary goal of this proposal. A measurement of viscosity also results from the Surface Light Scattering technique employed. Interfacial free energies between the phases enters into many analysis of phase transformation and flow, including nucleation, dendritic growth, interface stability, Ostwald ripening, and Marangoni flow. Succirionitrile (SCN) is useful as a model for the study of metal solidification, although it is an organic material, it has a BCC crystal structure and solidifies dendriticly like a metal. It is also transparent and has a low melting point (58.08 C). Succinonitrile has been and is being used extensively in NASAs Microgravity Materials Science and Fluid Physics programs and as well as in several ground-based and microgravity studies including the Isothermal Dendritic Growth Experiment (IDGE) due to Glicksman and coworkers and subsequently in several theoretical and numerical studies of dendritic growth. Previous measurements of succinonitrile (SCN) and alloys of succinonitrile and acetone surface tensions are extremely limited. We believe the data sought through this proposal have significant basic physical property data value and thus the work proposed will provide needed data in support of NASAs Microgravity program research.
Derived from text
Free Energy; Nitriles; Acetone; Alloys; Liquid-Vapor Interfaces; Fluid Dynamics; Interface Stability; Measure and Integration

20010058717 Cleveland State Univ., Cleveland, OH USA
Oxidation of ZrB2-SiC
Opila, Elizabeth J., Cleveland State Univ., USA; Halbig, Michael C., Army Research Lab., USA; [2001]; 8p; In English; 25th Annual International Conference on Advanced Ceramics and Composites, 21-26 Jan. 2001, Cocoa Beach, FL, USA; Sponsored by American Ceramic Society, USA
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In this paper the oxidation behavior of ZrB2-20 vol% SiC is examined. Samples were exposed in stagnant air in a zirconia furnace (Deltech, Inc.) at temperatures of 1327, 1627, and 1927 C for ten ten-minute cycles. Samples were removed from the furnace after one, five, and ten cycles. Oxidized material was characterized by mass change when possible, x-ray diffraction (XRD), scanning electron microscopy (SEM), and energy dispersive spectroscopy (EDS). Oxidation kinetics, oxide scale development, and matrix recession were monitored as a function of time and temperature. Oxidation and recession rates of ZrB2 - 20 vol% SiC were adequately modeled by parabolic kinetics. Oxidation rates of this material are rapid, allowing only very short-term application in air or other high oxygen partial pressure environments.
Author
Zirconium Oxides; Oxidation; Reaction Kinetics; X Ray Diffraction; Scanning Electron Microscopy

20010059237 NASA Glenn Research Center, Cleveland, OH USA
Burner Rig Hot Corrosion of Five Ni-Base Alloys Including Mar-M247
Nesbitt, James A., NASA Glenn Research Center, USA; Helmink, R., Rolls-Royce, Inc., USA; Harris, K., Cannon-Muskegon Corp., USA; Erickson, G., Cannon-Muskegon Corp., USA; [2000]; 14p; In English; Corrosion 2001, 11-16 Mar. 2001, Houston, TX, USA; Sponsored by National Association of Corrosion Engineers, USA
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The hot corrosion resistance of four new Ni-base superalloys was compared to that of Mar-M247 by testing in a Mach 0.3 burner rig at 900 C for 300 1-hr cycles. While the Al content was held the same as in the Mar-M247, the Cr and Co levels in the

four new alloys were decreased while other strengthening elements (Re, Ta) were increased. Surprisingly, despite their lower Cr and Co contents, the hot corrosion behavior of all four new alloys was superior to that of the Mar-M247 alloy. The Mar-M247 alloy began to lose weight almost immediately whereas the other four alloys appeared to undergo an incubation period of 50-150 1-hr cycles. Examination of the cross-sectional microstructures showed regions of rampant corrosion attack (propagation stage) in all five alloys after 300 1-hr cycles . This rampant corrosion morphology was similar for each of the alloys with Ni and Cr sulfides located in an inner subscale region. The morphology of the attack suggests a classic ”Type I”, or high temperature, hot corrosion attack.
Author
Nickel Alloys; Corrosion Resistance; Burners; Heat Resistant Alloys; Hot Corrosion

20010059383 NASA Glenn Research Center, Cleveland, OH USA
Long-Term Cyclic Oxidation Behavior of Uncoated and Coated Re-108 and In-939 at 980 and 870 C
Lee, K. N., NASA Glenn Research Center, USA; Barrett, C. A., NASA Glenn Research Center, USA; Smith, J., DYNACS Engineering Co., Inc., USA; Journal of Thermal Spray Technology; March 2000; Volume 9, No. 1, pp. 121-127; In English; Previously cited as 19990047780; Copyright; Avail: Issuing Activity

Very long-term cyclic oxidation behavior of Re108 and In939 with and without a protective coating was evaluated at 980 and 870 C, respectively. Re-108 and In-939 without a protective coating began to show a rapid weight loss at 3000 h due to scale spallation, indicating the need for an oxidation protective coating for longer than thousands of hours of oxidative life. NiAl-base coatings of a vapor phase aluminide (VPA), a pack aluminide (CODEP), and a slurry paint aluminide (SERMALOY J) were applied on Re-108 and In-939. The VPA and CODEP on Re-108 and all three coatings on In-939 showed excellent cyclic oxidation resistance out to 10,000 h. Coated alloys were annealed in an inert atmosphere to determine the loss of Al from the coating into the alloy substrate through diffusion. The Al loss from the coating through diffusion was twice as great as the Al loss through oxidation after 10,000 h of cyclic exposure. The oxidation life of VPA-coated Re-108 was estimated by calculating the amount of Al initially available for protective oxidation and the amount of Al lost through oxidation and diffusion.
Author
Aluminides; Protective Coatings; Oxidation Resistance; Vapor Phases; Oxidation

20010059942 California State Univ., Dept. of Physics and Astronomy, Northridge, CA USA
Electronic Structures and Mechanical Properties of Intermetallics ***Final Report, 1 Mar. 1997 - 30 Jun. 2000***
Kioussis, Nicholas; Dec. 15, 2000; 14p; In English
Contract(s)/Grant(s): DAAG55-97-1-0093
Report No.(s): AD-A388917; ARO-36340.4-PH; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

State-of-the-art first principles electronic structure calculations based on the full potential linear muffin tin orbital method and the pseudopotential method were employed to study systematically: (1) The electronic structure of the ”clean” tilt Sigma 5 grain boundary in Ni3Al; (2) The effect of hydrogen on the Sigma 5 grain boundary in Ni3Al; (3) The generalized stacking fault energy surface and dislocation properties of aluminum;(4) The correlation of the topology of the electronic charge density with the energetics and stability of planar faults in fcc metals; (5) The grain boundary sliding and the effect of vacancy on the grain boundary migration; (6) The unusual magnetic properties of the Cerium monopnictides and monochalcogenides; and (7) The ground state properties of the one dimensional Hubbard model at half filling in the presence of a magnetic field.
DTIC
Mechanical Properties; Density (Number/Volume); Electronic Structure; Intermetallics; Magnetic Properties; Nickel Alloys; Surface Properties

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.

20010054710 NASA Langley Research Center, Hampton, VA USA
Hollow Polyimide Microspheres
Weiser, Erik S., Inventor, NASA Langley Research Center, USA; St.Clair, Terry L., Inventor, NASA Langley Research Center, USA; Echigo, Yoshiaki, Inventor, NASA Langley Research Center, USA; Kaneshiro, Hisayasu, Inventor, NASA Langley Research Center, USA; May 22, 2001; 8p; In English; Division of US-Patent-Appl-SN-316865, filed 21 May 1999

Patent Info.: Filed 9 Sep. 1999; NASA-Case-LAR-15831-1; US-Patent-6,235,803; US-Patent-Appl-SN-408652; US-Patent-Appl-SN-316865; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

A shaped article composed of an aromatic polyimide has a hollow, essentially spherical structure and a particle size of about 100 to about 1500 micrometers, a density of about 1 to about 6 pounds/cubic foot and a volume change of 1 to about 20% by a pressure treatment of 30 psi for 10 minutes at room temperature. A syntactic foam, made of a multiplicity of the shaped articles which are bonded together by a matrix resin to form an integral composite structure, has a density of about 3 to about 30 pounds/cubic feet and a compression strength of about 100 to about 1400 pounds/sq inch.

Official Gazette of the U.S. Patent and Trademark Office

Polyimides; Microballoons; Foams; Composite Structures

20010054943 NASA Langley Research Center, Hampton, VA USA

Films, Preimpregnated Tapes and Composites Made from Polyimide ”Salt-Like” Solutions

Cano, Roberto J., Inventor, NASA Langley Research Center, USA; Weiser, Erik S., Inventor, NASA Langley Research Center, USA; St.Clair, Terry L., Inventor, NASA Langley Research Center, USA; Echigo, Yoshiaki, Inventor, NASA Langley Research Center, USA; Kaneshiro, Hisayasu, Inventor, NASA Langley Research Center, USA; Apr. 24, 2001; 12p; In English

Patent Info.: Filed 29 May 1998; NASA-Case-LAR-15745-1; US-Patent-6,222,007; US-Patent-Appl-SN-093826; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

High quality films, preimpregnated tape (prepegs), and composites have been fabricated from polyimide precursor ’saltlike’ solutions. These salt-like solutions have a low viscosity (5,000 to 10,000 cp) and a high solids content (50-65% by weight) and can be coated onto reinforcing fiber to produce prepegs with excellent tack and drape at 12-15% residual solvent (approximately 4-6% water from thermal imidization reaction). The processing of these types of prepegs significantly overcomes solvent removal problems and allows excellent fiber wet out. In addition, the physical characteristics of the polyimide precursor salt-like solutions permits processing into high-performance materials through the use of standard prepregging and composite fabrication equipment. The resultant composites are of high quality.

Official Gazette of the U.S. Patent and Trademark Office

Polyimides; Composite Materials

20010055272 NASA Ames Research Center, Moffett Field, CA USA

Refractory Oxidative-Resistant Ceramic Carbon Insulation

Leiser, Daniel B., Inventor, NASA Ames Research Center, USA; Hsu, Ming-Ta S., Inventor, NASA Ames Research Center, USA; Chen, Timothy S., Inventor, NASA Ames Research Center, USA; May 01, 2001; 8p; In English

Patent Info.: Filed 2 Nov. 1998; NASA-Case-ARC-14202-1; US-Patent-6,225,248; US-Patent Appl-SN-184415; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

High-temperature, lightweight, ceramic carbon insulation is prepared by coating or impregnating a porous carbon substrate with a siloxane gel derived from the reaction of an organodialkoxy silane and an organotrialkoxy silane in an acid or base medium in the presence of the carbon substrate. The siloxane gel is subsequently dried on the carbon substrate to form a ceramic carbon precursor. The carbon precursor is pyrolyzed, in an inert atmosphere, to form the ceramic insulation containing carbon, silicon, and oxygen. The carbon insulation is characterized as a porous, fibrous, carbon ceramic tile which is particularly useful as lightweight tiles for spacecraft.

Official Gazette of the U.S. Patent and Trademark Office

Carbon; Ceramics; Insulation

20010055589 NASA Langley Research Center, Hampton, VA USA

Method of Preparing Polymers with Low Melt Viscosity

Jensen, Brian J., Inventor, NASA Langley Research Center, USA; Feb. 20, 2001; 17p; In English; Continuation-in-part of US-Patent-Appl-SN-622176, filed 5 Mar. 1996

Patent Info.: Filed 18 Jun. 1996; NASA-Case-LAR-15534-1; US-Patent-6,191,252; US-Patent-Appl-SN-666793; US-Patent-Appl-SN-622176; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This invention is an improvement in standard polymerizations procedures, i.e., addition-type and step-growth type polymerizations, wherein monomers are reacted to form a growing polymer chain. The improvement includes employing an effective amount of a trifunctional monomer (such as a trifunctional amine anhydride, or phenol) in the polymerization procedure to form a mixture of polymeric materials consisting of branced polymers, star-shaped polymers, and linear polymers. This mixture

of polymeric materials has a lower melt temperature and a lower melt viscosity than corresponding linear polymeric materials of equivalent molecular weight.
Official Gazette of the U.S. Patent and Trademark Office
Polymerization; Monomers; Viscosity

20010055662 National Taiwan Ocean Univ., Dept. of Harbor and River Engineering, Keelung, Taiwan, Province of China
The Evaluation of Bond Degradation Between Rebar and Concrete Due to the Impressed Cathodic Current Using Interface Parameters
Chang, Jiang-Jhy, National Taiwan Ocean Univ., Taiwan, Province of China; Yeih, Wei-Chung, National Taiwan Ocean Univ., Taiwan, Province of China; Chang, Jenn-Chyan, National Scenic Area Administration Tourism Bureau, Taiwan, Province of China; Journal of the Chinese Institute of Engineers; March 2001; ISSN 0253-3839; Volume 24, No. 2, pp. 131-139; In English
Contract(s)/Grant(s): NSC-87-2211-E-019-011; Copyright; Avail: Issuing Activity

In this study, bond degradation between rebar and concrete due to impressed cathodic current is evaluated using four interface parameters. It was found that the shear stiffness per unit length, the critical debond shear force per length and the surface energy decreased as the impressed cathodic current density and/or the polarization time increased; however, the remaining shear force ratio, D, did not vary with the cathodic current density and the polarization time. A parameter, psi, which combined the effects of the current density and the polarization time, is proposed, and unified regression curves between this parameter and interface parameters have been obtained.
Author
Degradation; Joints (Junctions); Current Density

20010055669 3TEX, Inc., Cary, NC USA
Impact and High Strain Rate Response of 3-D Woven Systems ***Final Report, 17 Aug. 2000 - 17 Feb. 2001***
Singletary, J. N.; Coffelt, R. A.; Gillespie, J. W., Jr.; Gama, B. A.; Feb. 17, 2001; 71p; In English; Original contains color plates
Contract(s)/Grant(s): DAAD19-00-C-0108
Report No.(s): AD-A388847; TR-8; ARO-41472.1-EG-STI; No Copyright; Avail: CASI; A01, Microfiche; A04, Hardcopy

3-D and 2-D woven systems were characterized both statically and dynamically to assess the relative advantages of 3-D weaves in armor and impact resistant systems. Five different 3WeaveTM 3-D orthogonal fabrics were woven from S-2 glass rovings, including both flat goods and near-net-shape preforms. 3WeaveTM and a baseline, 2-D woven fabric were consolidated via vacuum assisted resin transfer molding using rubber toughened epoxy vinyl ester and rubber-toughened epoxy. Static mechanical properties, including mode 1 critical strain energy release rate, were determined. Composites were tested in drop tower impact, for visible damage area and compression strength after impact. Composites were tested in through-thickness compression in Hopkinson bar tests at strain rates ranging from 500-1200/s. Composites were used to back aluminum plates, and tested against fragment simulating projectiles in non-perforating ballistic impact, to determine visible damage area. Finally, prototype body armor inserts were developed, using alumina ceramics, which 3-D woven backings enabled the design to meet NlJ 0101.04 level 3 standalone requirements at an article weight of 8.1 lbs, while similar weight backings made from the 2-D fabric could not meet the NlJ requirements.
DTIC
Strain Rate; Impact Strength; Textiles; Weaving; Woven Composites; Resin Transfer Molding; Impact Damage; Fabrics

20010056268 Lehigh Univ., Dept. of Mechanical Engineering and Mechanics, Bethlehem, PA USA
Fracture Mechanics and Contact Problems in Materials Involving Graded Coatings and Interfacial Zones ***Final Report, 15 Oct. 1997 - 15 Apr. 2001***
Erdogan, Fazil; Apr. 2001; 112p; In English
Contract(s)/Grant(s): F49620-98-1-0028
Report No.(s): AD-A388613; Rept-533-046; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

Continuously grading the thermomechanical properties of materials is becoming a powerful tool in designing new materials for specific applications. Even though the potential application of the concept is very nearly unlimited, in the near future most likely fields of application of graded materials appear to be high-temperature components, load transfer components, components with high impact resistance and improved bonding strength, and thermoelectric cells. Thus, the primary objectives of this research program have been to identify specific fracture and contact problems the solutions of which are needed in the relevant failure analysis, to develop the necessary analytical and numerical methods for solving these problems, and to provide meaningful benchmark solutions in each area identified for investigation. Particular emphasis in the program has been on the investigation of failure-oriented problems. Considering the present and future applications, the main research efforts are therefore, concentrated

on fracture mechanics, contact mechanics and electrodynamics of graded materials. In this report after presenting the necessary review and background information on the application of graded materials, the objectives of the research programs and the summary of a series of benchmark solutions in the fields of fracture and contact mechanics involving graded coatings and interfaces are described.
DTIC
Failure Analysis; Fracture Mechanics; Coatings; Fracturing; Cracks

20010056399 NASA Langley Research Center, Hampton, VA USA
Method to Prepare Processable Polyimides with Non-Reactive Endgroups Using 1,3-bis(3-Aminophenoxy) Benzene
Jensen, Brian J., Inventor, NASA Langley Research Center, USA; Dec. 26, 2000; 9p; In English; Provisional of US-Patent-Appl-SN-096792, filed 5 Aug. 1998
Patent Info.: Filed 5 Aug. 1999; NASA-Case-LAR-15459-1; US-Patent-6,166,174; US-Patent-Appl-SN-368606; US-Patent-Appl-SN-096792; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Polyimide copolymers were obtained containing 1,3-bis(3-aminophenoxy)benzene (APB) and other diamines and dianhydrides and terminating with the appropriate amount of a non-reactive endcapper, such as phthalic anhydride. Homopolymers containing only other diamines and dianhydrides which are not processable under conditions described previously can be made processable by incorporating various amounts of APB, depending on the chemical structures of the diamines and dianhydrides used. Polyimides that are more rigid in nature require more APB to impart processability than polyimides that are less rigid in nature. The copolymers that result from using APB to enhance processability have a unique combination of properties including excellent thin film properties, low pressure processing (200 psi and below), improved toughness, improved solvent resistance, improved adhesive properties, improved composite mechanical properties, long term melt stability (several hours at 390 C), and lower melt viscosities.
Official Gazette of the U.S. Patent and Trademark Office
Polyimides; Copolymers; Anhydrides

20010056400 NASA Langley Research Center, Hampton, VA USA
Polyimide Precursor Solid Residuum
Weiser, Erik S., Inventor, NASA Langley Research Center, USA; St.Clair, Terry L., Inventor, NASA Langley Research Center, USA; Echigo, Yoshiaki, Inventor, NASA Langley Research Center, USA; Kaneshiro, Hisayasu, Inventor, NASA Langley Research Center, USA; Jan. 30, 2001; 14p; In English; Provisional US-Patent-Appl-SN-087272, filed 29 May 1998
Patent Info.: Filed 21 May 1999; NASA-Case-LAR-15767-1; US-Patent-6,180,746; US-Patent-Appl-SN-316428; US-Patent-Appl-SN-087272; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A polyimide precursor solid residuum is an admixture of an aromatic dianhydride or derivative thereof and an aromatic diamine or derivative thereof plus a complexing agent, which is complexed with the admixture by hydrogen bonding. The polyimide precursor solid residuum is effectively employed in the preparation of polyimide foam and the fabrication of polyimide foam structures.
Official Gazette of the U.S. Patent and Trademark Office
Polyimides; Admixtures

20010057204 Oklahoma Univ., School of Aerospace and Mechanical Engineering, Norman, OK USA
Microgravity Impregnation of Fiber Preforms
Altan, M. C., Oklahoma Univ., USA; Lai, F.-C., Oklahoma Univ., USA; Grady, B. P., Oklahoma Univ., USA; ORear, E. A., Oklahoma Univ., USA; Microgravity Materials Science Conference 2000; March 2001; Volume 1, pp. 27-32; In English; See also 20010057199; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A02, Hardcopy

Molding operations involving low-viscosity polymers are commonly used to manufacture net shape components quickly and inexpensively. Molding is usually characterized by the displacement of air in a cavity by a polymeric resin which is either cooled or cured to form the final solid part. During filling the interface between the polymer and the air, referred to as the free surface, progresses through the cavity. The dynamics of this free surface can affect heat transfer as well as the curing rate in the mold, and thus the mechanical properties of the molded part. During mold filling the bottom of the fluid front may sag due to gravity, thus forming a nonsymmetric free surface. The experimental and theoretical studies dealing with free surface shapes published in literature often do not approach the problem from a mold filling perspective. Those related to mold filling typically neglect gravity effects on the free surface. The most common approach in determining the free surface shapes in molding is to assume the capillary number is high and that viscous forces dominate surface forces. For instance Behrens et al. calculated and experimentally

measured axisymmetric free surface shapes. surface effects, such as those due to surface tension and contact angle, are ignored and the fluid front shape is completely dictated by the flow kinematics.
Author
Microgravity; Impregnating; Fibers; Preforms

20010057208 Yale Univ., Dept. of Mechanical Engineering, New Haven, CT USA
Forming of Thermoplastic Polymers in a Dynamic Decompression and Cooling Process
Song, KwangJin, Yale Univ., USA; Apfel, Robert E., Yale Univ., USA; Microgravity Materials Science Conference 2000; March 2001; Volume 1, pp. 52-56; In English; See also 20010057199; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A01, Hardcopy

Solutions of polymers in blowing liquids are decompressed into foams in a dynamic decompression and cooling (DDC) process. Adjustment of material and process conditions has allowed structure and properties of resultant foams to be varied substantially. The cellular structures of the foams are open or closed, with mean densities in the range from a low to medium level. The foamed polymers have micromorphologies of oriented fibers and fiber-networks, which tend to strengthen the materials. It is expected that in microgravity, DDC foaming will be able to produce uniform solutions of polymer/solid, resulting in foamed composites.
Author
Foaming; Thermoplasticity; Foams; Pressure Reduction; Solutions; Cooling

20010057209 Harvard Univ., Div. of Engineering and Applied Sciences, Cambridge, MA USA
Terrestrial Measurements of Diffusivities in Refractory Melts by Pulsed Melting of Thin Films
Sanders, Paul G., Harvard Univ., USA; Aziz, Michael J., Harvard Univ., USA; Microgravity Materials Science Conference 2000; March 2001; Volume 1, pp. 57-62; In English; See also 20010057199; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A02, Hardcopy

Laterally homogeneous pulsed melting of thin films is being investigated as a way to eliminate convection and thereby determine diffusivities in refractory melts under terrestrial conditions, providing comparison data for microgravity measurements. The silicon liquid self-diffusivity was determined by pulsed laser melting of Si-30(+) ion implanted silicon-on-insulator thin films. The broadening of nearly Gaussian solute concentration-depth profiles was determined ex situ using Secondary Ion Mass Spectrometry. Melt depth versus time and total melt duration were monitored by time-resolved lateral electrical conductance and optical reflectance measurements. One-dimensional diffusion simulations were utilized to match the final Si-30(+) experimental concentration spatial profile given the initial concentration profile and the temporal melt-depth profile. The silicon liquid self-diffusivity at the melting point is (4.0 +/- 0.5) x 10(exp -4) sq cm/s. Calculations of buoyancy and Marangoni convection indicate that convective contamination is unlikely.
Author
Diffusivity; Refractories; Melts (Crystal Growth); Thin Films

20010057218 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; Microgravity Materials Science Conference 2000; March 2001; Volume 1, pp. 109-112; In English; See also 20010057199; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A01, Hardcopy

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 [1]. Further, by casting from a liquid suspension and subsequently sintering, many complex parts and shapes can be fabricated [2]. 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 [3,4]. It is well know that solids fractions

of 90% can be obtained with a bidisperse suspension of spherical particles. and 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 [5]. 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.
Author
Ceramics; Rheology; Microstructure; Casting; Brittleness

20010057220 Tufts Univ., Dept. of Physics and Astronomy, Medford, MA USA
Study of Development of Polymer Structure in Microgravity Using Ellipsometry
Georgiev, Georgi, Tufts Univ., USA; Berns, David, Tufts Univ., USA; Cebe, Peggy, Tufts Univ., USA; Microgravity Materials Science Conference 2000; March 2001; Volume 1, pp. 116-120; In English; See also 20010057199; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A01, Hardcopy

Crystalline or liquid crystalline polymers processed from solution or from the quiescent melt exhibit optical birefringence as a result of formation of superstructures, such as spherulites, axialites, dendrites or liquid crystalline phases. In other types of processing, stresses imposed on the polymer during processing result in anisotropic alignment of the polymer chains, leading again to birefringence. The first objective of this investigation is to provide a method for real-time, in-situ characterization of optical anisotropy which can develop in polymeric materials processed or treated in the microgravity environment. Our method of choice for optical characterization is a variation of ellipsometry based on Stokes analysis [1,2]. We use ellipsometry to measure the retardation and azimuthal angle of optically anisotropic polymeric materials in real-time, during processing or treatment. In addition, the embodiment of the method provides two-dimensional, i.e., spatially resolved, information about the optical parameters across the field of view. Unlike conventional reflection ellipsometry with coherent light sources, our method uses transmission of monochromatic, incoherent, light for image analysis. High speed detection allows image collection at video rates. A second objective of the work is to apply this novel instrument to ground-based studies of the development of structure in polymeric, and liquid crystalline polymeric (LCP), materials. We aim to provide fundamental information about the formation of optically anisotropic structure, including measurement of phase transformation kinetics and development of textures. The construction of the instrument has now been completed. As shown in Figure 1, the instrument consists of the following components: (1) monochromatic, incoherent light source; (2) heat absorber; (3) interference filter; (4) mirror (5) fixed-orientation linear polarizer; (6,7) precision universal compensator comprising two voltage-controlled liquid crystal variable phase retarders; (8) sample mounting stage with manual translation and rotation; (9) long working distance objective lens; (10) left circular analyzer; (11, 12) CCD camera; and, (14) computer for data collection and analysis of images with frame grabber card and software. For high temperature work, a Mettler hot stage (8) and its controller (13) are used.
Author
Crystallinity; Liquid Crystals; Polymers; Liquid Phases; High Temperature

20010057228 Illinois Univ. at Urbana-Champaign, Dept. of Mechanical and Industrial Engineering, Urbana, IL USA
Phase Field Modeling of Microstructure Development in Microgravity
Dantzig, Jonathan A., Illinois Univ. at Urbana-Champaign, USA; Goldenfeld, Nigel, Illinois Univ. at Urbana-Champaign, USA; Microgravity Materials Science Conference 2000; March 2001; Volume 1, pp. 157; In English; See also 20010057199; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

This newly funded project seeks to extend our NASA-sponsored project on modeling of dendritic microstructures to facilitate collaboration between our research group and those of other NASA investigators. In our ongoing program, we have applied advanced computational techniques to study microstructural evolution in dendritic solidification, for both pure isolated dendrites and directionally solidified alloys. This work has enabled us to compute dendritic microstructures using both realistic material parameters and experimentally relevant processing conditions, thus allowing for the first time direct comparison of phase field computations with laboratory observations. This work has been well received by the materials science and physics communities, and has led to several opportunities for collaboration with scientists working on experimental investigations of pattern selection and segregation in solidification. While we have been able to pursue these collaborations to a limited extent, with some important findings, this project focuses specifically on those collaborations. We have two target collaborations: with Prof. Glicksman's group working on the Isothermal Dendritic Growth Experiment (IDGE), and with Prof. Poirier's group studying directional solidification in Pb-Sb alloys. These two space experiments match well with our two thrusts in modeling, one for pure materials,

as in the IDGE, and the other directional solidification. Such collaboration will benefit all of the research groups involved, and will provide for rapid dissemination of the results of our work where it will have significant impact.
Author
Dendritic Crystals; Directional Solidification (Crystals); Microstructure; Microgravity; Crystal Growth; Mathematical Models

20010057239 Virginia Commonwealth Univ., Dept. of Chemistry, Richmond, VA USA
Nucleation and Polymerization Experiments in the Vapor Phase
Rusyniak, M., Virginia Commonwealth Univ., USA; Pithawalla, Y. B., Virginia Commonwealth Univ., USA; El-Shall, M. S., Virginia Commonwealth Univ., USA; Microgravity Materials Science Conference 2000; March 2001; Volume 1, pp. 204-209; In English; See also 20010057199; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A02, Hardcopy

This research project is focused on two interrelated processes that can be affected by microgravity: (1) Vapor-to-liquid homogeneous and ion-induced nucleation, and (2) Polymerization and nanoparticles' formation from the gas phase. In the nucleation research we focus on three important areas. The first is the effect of carrier gas pressure on the rate of homogeneous nucleation from the vapor phase. The second and third areas involve studies of oscillatory and ion-induced nucleation, respectively. In the polymerization studies, we provide evidence for the initiation of gas phase polymerization of isoprene and propene using direct and coupled charge transfer mechanisms from the benzene radical cation.
Author
Nucleation; Polymerization; Pressure Effects; Vapor Phases; Microgravity; Chemical Reactions

20010057245 Middle Tennessee State Univ., Dept. of Chemistry, Murfreesboro, TN USA
Thermal Stability and Conductivity Properties of Monomeric and Polymeric Oxanorbornenes
Trznadel, Miroslaw, Middle Tennessee State Univ., USA; Manka, Jason T., Middle Tennessee State Univ., USA; Kaszynski, Piotr, Middle Tennessee State Univ., USA; Friedli, Andrienne C., Middle Tennessee State Univ., USA; Microgravity Materials Science Conference 2000; March 2001; Volume 1, pp. 234-238; In English; See also 20010057199; CD-ROM contains the entire Conference Proceedings presented in PDF format
Contract(s)/Grant(s): PRF 30202-GB7; No Copyright; Avail: CASI; A01, Hardcopy

The goal of our research is to develop a new class of anionic polymer electrolytes for use in organic solid state batteries. The resulting devices are expected to be lightweight and non-toxic with applications in energy storage and power supply for the human exploration and development of space, as well as for communications devices on Earth. Critical characteristics for successful ion-conducting materials are high cation mobility, electrochemical/chemical stability, and high charge density. Here we report progress toward organic solid state electrolyte systems which are designed to satisfy these requirements. The key feature of our electrolyte design is the identity of the charged groups, which affect the mobility of counterions. We have selected the diffuse spherical closo-boron clusters, B10H10(2-) and B12 H12(2-), which contain boron and hydrogen, and the monocarbaborate cluster, CB11H12(1-). These clusters carry delocalized charges and may be derivatized or be covalently attached into a polymeric structure. The spherical electrostatic field generated by the clusters can stabilize new-by positive charges, potentially promoting high mobility of cations (especially Li(+)) in polymer solutions. Another important structural feature of materials appropriate for polyelectrolytes appears to be flexibility and a high oxygen-to-carbon atom ratio. In compliance with this empirical requirement, we have incorporated oligoethylene glycol chains, which promote conductivity of ions, into all of our polymers. to simplify polymer purification and processing, the polymers or copolymers should be soluble, have a reproducible distribution of molecular weights, and the polymerization conditions should be tolerant of charged groups. Given these restrictions, we chose to begin our investigation with polymers formed by ring opening metathesis polymerization (ROMP) of 7-oxabicyclo[2.2.1]-hept-2-ene derivatives (oxanorbornenes) such as 1a. ROMP may be carried out in either aqueous or organic solutions, and results in low polydispersity, stable polymers with semi-rigid backbone structures. Established ROMP methodology to form poly(la) and derivatives, as well as emerging understanding of the resulting polymer microstructure, make this backbone structure ideal for our purposes. Appropriate derivatives of poly(1) have the potential to be soluble, non-toxic, stable polymers with a variety of charged groups, and are expected to be good candidates for battery materials. Two approaches to boron-containing solid-state electrolytes were pursued using the general strategy described above. A polymer electrolyte design relies on the doping of lithium salts of boron clusters into homopolymer poly(1b). The polyelectrolyte design incorporates boron clusters into the poly(1c) polymer through covalent bonding.
Author
Copolymers; Electric Charge; Electrolytes; Thermal Stability; Ionic Mobility; Cations

20010057246 Pennsylvania State Univ., Center for Innovative Sintered Products, University Park, PA USA

Gravitational Effects on Distortion in Sintering

German, Randall M., Pennsylvania State Univ., USA; Iacocca, Ronald G., Pennsylvania State Univ., USA; Microgravity Materials Science Conference 2000; March 2001; Volume 1, pp. 239-243; In English; See also 20010057199; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A01, Hardcopy

Liquid phase sintering (LPS) is used to fabricate high-performance, net-shape structures from powders. The powders are shaped into an oversized structure that densifies to a target size. When a liquid forms during sintering, it generates a capillary stress that combines with rapid atomic motion to densify the structure. Models for LPS treat the pores between the powders as permeable balloons in the microstructure that progressively fill by atomic diffusion. Density differences between the solid, liquid, and pore phases result in phase separation resulting in different compositions and properties between the component top and bottom. Along with phase separation, gravity also causes shape distortion, which denies the benefit of net-shape processing. to avoid these problems, industry restricts the use of LPS to compositions with high solid contents. Consequently, the property ranges attainable via LPS are constrained by gravitational effects. If these problems could be solved, then many useful materials and devices would be fabricated net-shape by LPS. Examples opportunities are seen in high thermal conductivity heat sinks for computers, tougher cutting tools for machining, high precision automotive transmission gears, and more corrosion and wear resistant molds for plastic shaping.

Author

Distortion; Gravitational Effects; Liquid Phase Sintering; Phase Separation (Materials)

20010057252 INTEL Corp., Santa Clara, CA USA

Influence of Solutocapillary Convection on Macrovoid Defect Formation in Polymeric Membranes

Pekny, M. R., INTEL Corp., USA; Zartman, J., Colorado Univ., USA; Greenberg, A. R., Colorado Univ., USA; Todd, P., Space Hardware Optimization Technology, Inc., USA; Krantz, W. B., Cincinnati Univ., USA; Microgravity Materials Science Conference 2000; March 2001; Volume 1, pp. 273-278; In English; See also 20010057199; CD-ROM contains the entire Conference Proceedings presented in PDF format

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Macrovoids (MVs) are large (10-50 micrometers) pores often found in polymeric membranes prepared via phase-inversion techniques. They are generally considered undesirable, as they adversely affect the permeability properties and performance of polymeric membranes for microfiltration, ultrafiltration, and reverse osmosis. However, MVs can be useful in certain thin-film applications in which vapor transmission is necessary, or for use as reservoirs for enzymes or liquid membrane material. If more could be learned about the nature and causes of MV formation, it might be possible to devise techniques to control and/or prevent MV formation that are more effective than those currently employed. Two hypotheses for the MV growth mechanism have been advanced. Reuvers proposed that once initiated, MV growth can be attributed to diffusion of (primarily) solvent to the MV nuclei. Because this mechanism does not involve gross movement of the MV, the presence or absence of body forces such as buoyancy should not significantly affect MV growth. On the other hand, Shojaie et al. proposed that solutocapillary convection induced by a steep surface-tension gradient along the MV/bulk solution interface enhances mass transfer to the growing MV. This interfacial convection exerts a force that pulls the growing MV downward into the casting solution. Both buoyancy and viscous drag hinder MV growth by inhibiting this motion. Thus, removing the buoyancy force by casting in microgravity should augment MV growth according to this hypothesis. Whereas neither surface tension nor gravity has a significant effect on MV growth according to the first hypothesis, buoyancy forces should be important if the second hypothesis is correct. The overall goal of this research is to test these two hypotheses in order to improve our understanding of the MV growth processing solvent-cast polymeric membranes. Studying MV growth in low-gravity conditions is pivotal to our ability to discriminate between these two hypotheses.

Derived from text

Hypotheses; Capillary Flow; Membranes; Polymeric Films; Growth

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Polymersomes: Tough, Giant Vesicles Made from Diblock Copolymers

Hammer, D. A., Pennsylvania Univ., USA; Discher, D. E., Pennsylvania Univ., USA; Bates, F. S., Minnesota Univ., USA; Discher, B., Pennsylvania Univ., USA; Won, Y.-Y., Minnesota Univ., USA; Lee, C. M., Pennsylvania Univ., USA; Bermudez, H., Pennsylvania Univ., USA; Brannan, A., Minnesota Univ., USA; Microgravity Materials Science Conference 2000; March 2001; Volume 2, pp. 293-294; In English; See also 20010057256; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A01, Hardcopy

Phospholipid vesicles have long been proposed as a method for encapsulating drugs or carrying oxygen and other solutes. However, phospholipid vesicles are mechanically weak and unstable, preventing their useful application or long-term storage.

to improve the material properties of water-soluble spherical encapsulators, we hypothesized that amphiphilic block copolymers would, for some regime of molecular weights and block chemistries, serve as an effective substitute for phospholipids. We reasoned that block copolymers that form lamellar phases at dilute concentration at room temperature are likely candidates for making bilayer membranes. The ability to control the molecular weight and chemistry of block copolymers over a wide range, as well as the potential to crosslink polymers, suggests that we could modulate the material properties of the polymer membranes, and perhaps more closely approach the mechanical stability of biological cells. Polymeric vesicles have been made from polyethylene oxide (PEO) diblock copolymers with either polyethylethylene (PEE) or polybutadiene (PB) tails. The vesicles were made by either electroformation of polymer from a platinum wire in aqueous solution using an oscillatory electric field, or by rehydration of polymers from a glass surface. They proved to be much tougher than typical phospholipid membranes, as measured by micropipette aspiration. We have also demonstrated that reagents such as oxygen binding molecules or fluorophores can be readily incorporated with the vesicle interior, leading toward potential applications such as artificial blood or imaging materials. Author

Block Copolymers; Encapsulating; Membranes

20010057263 NASA Marshall Space Flight Center, Huntsville, AL USA

Porosity and Variations in Microgravity Aerogel Nano-Structures, 2, New Laser Speckle Characterization Methods

Hunt, A. J., California Univ., Lawrence Berkeley Lab., USA; Ayers, M. R., California Univ., Lawrence Berkeley Lab., USA; Sibille, L., NASA Marshall Space Flight Center, USA; Smith, D. D., NASA Marshall Space Flight Center, USA; Microgravity Materials Science Conference 2000; March 2001; Volume 2, pp. 316-321; In English; See also 20010057256; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A02, Hardcopy

The transition from sol to gel is a process that is critical to the properties of engineered nanomaterials, but one with few available techniques for observing the dynamic processes occurring during the evolution of the gel network. Specifically, the observation of various cluster aggregation models, such as diffusion-limited and reaction-limited cluster growth can be quite difficult. This can be rather important as the actual aggregation model can dramatically influence the mechanical properties of gels, and is significantly affected by the presence of convective flows, or their absence in microgravity. We have developed two new non-intrusive optical methods for observing the aggregation processes within gels in real time. These make use of the dynamic behavior of laser speckle patterns produced when an intense laser source is passed through a gelling sol. The first method is a simplified time-correlation measurement, where the speckle pattern is observed using a CCD camera and information on the movement of the scattering objects is readily apparent. This approach is extremely sensitive to minute variations in the flow field as the observed speckle pattern is a diffraction-based image, and is therefore sensitive to motions within the sol on the order of the wavelength of the probing light. Additionally, this method has proven useful in determining a precise time for the gel-point, an event often difficult to measure. Monitoring the evolution of contrast within the speckle field is another method that has proven useful for studying aeration. In this case, speckle contrast is dependent upon the size (correlation length) and number of scattering centers, increasing with increasing size, and decreasing with increasing numbers. The dynamic behavior of cluster growth in gels causes both of these to change simultaneously with time, the exact rate of which is determined by the specific aggregation model involved. Actual growth processes can now be observed, and the effects of varying gravity fields on the growth processes qualitatively described. Results on preliminary ground-based measurements have been obtained.
Author

Aerogels; Nanostructure (Characteristics); Sol-Gel Processes; Speckle Patterns

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Physical Properties and Processing of Undercooled Metallic Glass Forming Melts

Johnson, W. L., California Inst. of Tech., USA; Geyer, U., California Inst. of Tech., USA; Schroers, J., California Inst. of Tech., USA; Hays, C., California Inst. of Tech., USA; Microgravity Materials Science Conference 2000; March 2001; Volume 2, pp. 332-333; In English; See also 20010057256; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A01, Hardcopy

Well known examples of diffusion-controlled reactions in solids and liquids are nucleation of new phases, precipitation and dissolution of phases, decomposition, diffusive phase transformations, recrystallization, diffusive creep, and thermal oxidation. Diffusion in liquids and non-crystalline media is of particular interest because it is strongly connected with atomic rearrangement phenomena like structural relaxation, decomposition, and crystallization, which are specific for these disordered systems. Precise and reliable diffusion experiments in the equilibrium melt and undercooled liquid state of metal alloys have, to our best knowledge, still to be performed. More particularly, the temperature dependence of atomic diffusion, along with viscosity in bulk metallic glass forming liquids, is a direct signature of the glass transition. Over the undercooled range, both atomic diffusion constants and viscosities change by roughly 14 orders of magnitude. The temperature dependence has been discussed in terms of the concept

of ”fragility”. The functional form of the temperature dependence and the scaling relations between atomic diffusion coefficients and fluidity are of particular interest. In other organic and non-metallic glass formers, the atomic diffusion coefficients have been observed to ”decouple” from fluidity. On going from pure metals to binary alloys to bulk metallic glass formers, it has been shown that the undercooled liquid progressively changes from a ”fragile” (pure metals) to a ”strong” (silicates and bulk metallic glass forming alloys) behavior. As such, one can traverse the full range of liquid behavior. Viscosity measurements have already successfully been conducted in ground-based experiments using a variety of methods such as beam bending, parallel plate rheometry, capillary flow viscometry, and rotating cup viscometry. High temperature viscosity of glass forming liquids was obtained by using drop oscillation techniques under microgravity conditions using the TEMPUS facility during the IML-2 and MSL-1 missions of the space shuttle.
Author
Melts (Crystal Growth); Metallic Glasses; Physical Properties; Supercooling

20010057268 Tufts Univ., Dept. of Chemical Engineering, Medford, MA USA
Hierarchical Assembly of Collagen
Valluzzi, Regina, Tufts Univ., USA; Martin, Raquel, Tufts Univ., USA; Wilson, Donna, Tufts Univ., USA; Kaplan, David L., Tufts Univ., USA; Microgravity Materials Science Conference 2000; March 2001; Volume 2, pp. 334-339; In English; See also 20010057256; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A02, Hardcopy

An understanding of macromolecular assembly is a cornerstone in polymer science, since the ability to design polymers that can ’assemble themselves,’ starting from the molecular scale, offer, exciting opportunities in future materials design and fabrication on the ground as well as in space. Collagen is a critical component in almost all tissues in the human body. These protein polymers function as the main structural components or scaffolds in tissues. Collagens provide surfaces upon which cell growth and development occurs and are involved in many disease states that can severely impact physiological function. Despite these essential roles for collagens in our body, very little is known about how complex collagen structures in tissue are formed. While there is a good understanding of how collagen proteins become organized into triple helices or rope like structures, the formation of more complex organized structures that form the basis of bone, ligaments, skin and many other tissues is not understood. This process can be called self-assembly or long-range order generation, since all of the information required for this process has to be contained within the sequences of the collagen proteins themselves, or influenced by some environmental factor during the assembly. Liquid crystallinity, the formation of an organized and orientated liquid prior to solidification, provides a pathway for self-assembly of long range ordered structures. An analogy to this problem on a larger scale would be the structure of wood composites, such as plywood. The layers in plywood are organized in different orientations. This structural organization forms a material with mechanical properties that exceed those of the individual layers. This type of structural organization also ensures that there is no weak direction or orientation for the material, since each layer resists cracking or breaking most strongly in a different and complimentary direction. The scale at which this level of structural control is achieved in biological systems such as collagens is significantly smaller than that in this plywood analogy, and this leads to important functional properties. In contrast to the plywood analogy, self-assembled proteins can be designed with different functional regions along their length, resulting in a pattern of functional group availability and orientation at the surface of the material when it solidifies from a liquid crystalline phase.
Author
Collagens; Self Assembly; Macromolecules

20010057279 Illinois Univ. at Urbana-Champaign, Dept. of Materials Science and Engineering, Urbana, IL USA
Phase Behavior of Asymmetric Binary Colloid Mixtures: Influence on Colloidal Processing of Ceramics
Lewis, J. A., Illinois Univ. at Urbana-Champaign, USA; Microgravity Materials Science Conference 2000; March 2001; Volume 2, pp. 377-381; In English; See also 20010057256; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A01, Hardcopy

This ground-based research program aims to develop a fundamental understanding of the phase behavior of binary colloidal suspensions. Such systems are utilized in numerous applications including advanced ceramics, photonic band gap materials, and porous assemblies for sensors and membranes. Specifically, we have studied transitions between the fluid, gel, and crystalline states exhibited by asymmetric binary colloid mixtures of attractive, large colloidal spheres and highly repulsive nanoparticles. In addition, we have investigated the impact of such transitions on the stability, rheological properties, and structural evolution during assembly of these complex systems.
Author
Asymmetry; Binary Mixtures; Ceramics; Colloids

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Influence of Natural Convection and Thermal Radiation on Multicomponent Transport and Chemistry in MOCVD Reactors

Lowry, S., CFD Research Corp., USA; Mazumder, S., CFD Research Corp., USA; Sengupta, D., CFD Research Corp., USA; Microgravity Materials Science Conference 2000; March 2001; Volume 2, pp. 394-400; In English; See also 20010057256; CD-ROM contains the entire Conference Proceedings presented in PDF format

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The influence of natural convection and thermal radiation number on multi-component transport and chemistry in Metal Organic Chemical Vapor (MOCVD) reactors is systematically investigated. This research uses empirical data in conjunction with numerical analysis. The numerical code includes advanced models for the effects of convection, conduction, and radiation as well as multi-component diffusion and multi-step surface/gas phase chemistry. Advanced radiation models include non-gray effects, thin films, and specular reflections. Thermal simulations are performed and validated for a range of operating condition for a tube reactor in collaboration with empirical studies at NASA LaRC. This same reactor is used to evaluate the relationship between the Richardson number (Gr/Re2) and the relative magnitude of natural convection. The reactor is subsequently used to investigate the significance of multi-step chemistry mechanisms for InP and GaAs, using published data from the University of Virginia. In parallel, the need and benefits of microgravity conditions for a proposed North Carolina high pressure pulsed reactor study are demonstrated. The numerical model, improved in part under this study, is being successfully applied by commercial equipment manufactures to analyze their systems. Selected examples are provided for the analysis of some these commercial reactors for normal and off design operating conditions.

Author

Metalorganic Chemical Vapor Deposition; Thermal Radiation; Free Convection; Mathematical Models; Radiation Effects; Chemical Reactors

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Novel Microstructures for Polymer-Liquid Crystal Composite Materials

Magda, Jules J., Utah Univ., USA; Smith, Grant D., Utah Univ., USA; Glaser, Matthew A., Colorado Univ., USA; Clark, Noel A., Colorado Univ., USA; Bowman, Christopher, Colorado Univ., USA; Radzihovsky, Leo, Colorado Univ., USA; Microgravity Materials Science Conference 2000; March 2001; Volume 2, pp. 409-410; In English; See also 20010057256; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A01, Hardcopy

Key to understanding and optimizing the structure of polymer/liquid crystal composites and to developing novel electro-optic applications of these materials is control over the liquid crystal interface. Two molecular-based computer simulation models are being used in tandem to improve scientific understanding of the liquid crystal interface, and to predict the effects of changes in the chemical structure of the liquid crystal molecule.

Author

Liquid Crystals; Microstructure; Composite Materials; Polymers

20010057289 Alabama Univ., Dept. of Chemistry, Birmingham, AL USA

Controlled Synthesis of Nanoparticles Using Block Copolymers: Nanoreactors in Microgravity Conditions

Mays, Jimmy W., Alabama Univ., USA; Advincula, Rigoberto, Alabama Univ., USA; Claude, Juan Pablo, Alabama Univ., USA; Microgravity Materials Science Conference 2000; March 2001; Volume 2, pp. 422; In English; See also 20010057256; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

Nanoparticles (particles having sizes of 2-10 nm) of semiconductor and metallic materials (like CdS, ZnS, Cu2S, Au, and Co) are expected to play a significant role in the development of new microelectronic and electro-optical technologies in the near future. In order to achieve complete control over the nanoparticle's properties, as required for several important applications, it is necessary to produce samples that are as uniform in size and shape as possible. Despite much work by many research groups using different strategies for nanoparticle growth, the formation of monodisperse nanoparticles has not yet been achieved. We are exploring strategies for nanoparticle growth within "nanoreactors" composed of various block copolymer assemblies. These assemblies include block copolymer micelles, star-block copolymers, polymacromonomers, and bulk microphase separated block copolymer films. The chemistries of these polymeric materials will be chosen so that one component will bind to, or react with, inorganic compounds (precursors to the semiconductors or metals), while the other component will be non-reactive and will

provide stabilization. By confining particle growth to specific regions of the copolymer vessels, control over nanoparticle size and shape may be achieved. Additional information is contained in the original extended abstract.
Author
Semiconductors (Materials); Nanocrystals; Nanostructures (Devices); Block Copolymers; Microgravity; Nanostructure (Characteristics); Crystal Growth; Synthesis (Chemistry); Metals; Reactors

20010057294 NASA Langley Research Center, Hampton, VA USA
Radiation Transport Properties of Potential In Situ-Developed Regolith-Epoxy Materials for Martian Habitats
Miller, J., California Univ., Lawrence Berkeley Lab., USA; Heilbronn, L., California Univ., Lawrence Berkeley Lab., USA; Singleterry, R. C., Jr., NASA Langley Research Center, USA; Thibeault, S. A., NASA Langley Research Center, USA; Wilson, J. W., NASA Langley Research Center, USA; Zeitlin, C. J., California Univ., Lawrence Berkeley Lab., USA; Microgravity Materials Science Conference 2000; March 2001; Volume 2, pp. 446; In English; See also 20010057256; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

We will evaluate the radiation transport properties of epoxy-martian regolith composites. Such composites, which would use both in situ materials and chemicals fabricated from elements found in the martian atmosphere, are candidates for use in habitats on Mars. The principal objective is to evaluate the transmission properties of these materials with respect to the protons and heavy charged particles in the galactic cosmic rays which bombard the martian surface. The secondary objective is to evaluate fabrication methods which could lead to technologies for in situ fabrication. The composites will be prepared by NASA Langley Research Center using simulated martian regolith. Initial evaluation of the radiation shielding properties will be made using transport models developed at NASA-LaRC and the results of these calculations will be used to select the composites with the most favorable radiation transmission properties. These candidates will then be empirically evaluated at particle accelerators which produce beams of protons and heavy charged particles comparable in energy to the radiation at the surface of Mars.
Author
Radiation Transport; Transport Properties; Regolith; Mars Surface; Fabrication; Epoxy Matrix Composites; Transmissivity; Space Habitats; Space Processing

20010057301 University of Southern Mississippi, Dept. of Chemistry and Biochemistry, Hattiesburg, MS USA
Frontal Polymerization in Microgravity: Bubble Behavior and Convection on the KC-135 Aircraft
Pojman, John A., University of Southern Mississippi, USA; Ainsworth, William, University of Southern Mississippi, USA; Chekanov, Yuri, University of Southern Mississippi, USA; Masere, Jonathan, University of Southern Mississippi, USA; Volpert, Vitaly, Lyon-1 Univ., France; Dumont, Thierry, Lyon-1 Univ., France; Wilke, Hermann, Institute of Crystal Growth, Germany; Microgravity Materials Science Conference 2000; March 2001; Volume 2, pp. 477-482; In English; See also 20010057256; CD-ROM contains the entire Conference Proceedings presented in PDF format
Contract(s)/Grant(s): NAG8-973; No Copyright; Avail: CASI; A02, Hardcopy

Frontal polymerization is a mode of converting monomer into polymer via a localized exothermic reaction zone that propagates through the coupling of thermal diffusion and Arrhenius reaction kinetics. Frontal polymerization was discovered in Russia by Chechilo and Enikolopyan in 1972. The macrokinetics and dynamics of frontal polymerization have been examined in detail and applications for materials synthesis considered. Large temperature and concentration gradients that occur in the front lead to large density gradients. A schematic is presented for a liquid monomer, usually a monoacrylate, being converted to a liquid (thermoplastic) polymer. The velocity can be controlled by the initiator concentration but is on the order of a cm/min. If the liquid monomer is multifunctional, then a solid (thermoset) polymer is formed. Convection can occur with all types of monomers if the front propagates up a tube. Bowden et al. studied liquid/solid systems. McCaughey et al. studied liquid polymer systems. Descending fronts in thermoplastic systems are also susceptible to the Rayleigh-Taylor instability.
Author
Polymerization; Reaction Kinetics; Microgravity; Spaceborne Experiments; Bubbles; Monomers; Polymers; Convection; Thermoplastic Resins

20010057303 State Univ. of New York, Dept. of Materials Science and Engineering, Stony Brook, NY USA
Microgravity Processing of Polymer Thin Films
Rafailovich, Miriam H., State Univ. of New York, USA; Microgravity Materials Science Conference 2000; March 2001; Volume 3, pp. 483-486; In English; See also 20010057302; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A01, Hardcopy

Polymeric materials are often reinforced with inorganic fillers in order to enhance such properties as mechanical toughness, thermal degradation, and UV and other radiation stability. Even though a great deal of research has been done on the bulk materials, little is known about the effects of fillers on the stability of thin films. In the past our group has done extensive research on dewetting of polymer bilayers near inorganic planar interfaces. We would like to extend our knowledge of interfacial properties to the study of fillers where the interfaces are more complex. The main questions we then wish to answer are: (1) What is the effect of the filler on polymer chain dynamics and hence film viscosity? (2) Can we control film stability by varying the interaction at the interface between the polymer matrix and the filler?
Author
Fillers; Space Processing; Thin Films; Polymers; Gold; Polymethyl Methacrylate; Interfaces; Interface Stability; Surface Reactions; Matrix Materials

20010057308 University of Southern California, Dept. of Aerospace and Mechanical Engineering, Los Angeles, CA USA
Extinction and Instability Mechanisms of Polymerization Fronts
Abid, M., University of Southern California, USA; Ronney, Paul D., California Univ., USA; Meiburg, Eckard, California Univ., USA; Microgravity Materials Science Conference 2000; March 2001; Volume 3, pp. 510-515; In English; See also 20010057302; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A02, Hardcopy

Recent advances in polymer chemistry have led to the development of monomers and initiation agents providing propagating polymerization fronts driven by the exothermicity of the polymerization reaction and the transport of heat from the polymerized product to the monomer. The use of polymerization processes based on this mode of polymerization has many applications including rapid curing of polymers without external heating, uniform curing of thick samples, solventless preparation of some polymers, and filling/sealing of structures having cavities of arbitrary shape without having to heat the structure externally. One important limitation of this process is that the fronts extinguish when they try to propagate through channels that are too narrow (probably due to conductive heat losses) or too wide (for unknown reasons, which we propose to be convective heat losses driven by buoyancy induced flow.) Even when extinction does not occur, convective and buoyant instabilities can affect the structure and properties of the resulting polymerized materials as well as the propagation rates of the fronts. The purpose of the proposed study is to determine the mechanisms of extinction and instability and thereby determine means to obtain more useful product material at earth gravity and microgravity.
Author
Extinguishing; Microgravity; Monomers; Polymer Chemistry; Polymerization; Chemical Reactions; Combustion; Flames; Marangoni Convection; Temperature Gradients; Heat Transfer

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Influence of Processing on the Dynamical Properties of Glassy Networks
Agladze, N. I., Cornell Univ., USA; Sievers, A. J., Cornell Univ., USA; Microgravity Materials Science Conference 2000; March 2001; Volume 3, pp. 539-542; In English; See also 20010057302; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A01, Hardcopy

Low temperature specific heat measurements on glasses reveal a linear temperature dependence quite different from that found for crystals. The introduction of two level systems (TLS's), in which the low lying dynamics of amorphous materials is characterized by atoms or groups of atoms tunneling, has enjoyed outstanding success in explaining this and other observations, with an admittedly parameterized model. Although these materials have been studied for over 20 years with a variety of experimental techniques and theoretical descriptions, the source of the TLS's described in these original proposals remains a mystery. Two basic questions remain unanswered: why the density of tunneling states is comparable for all amorphous substances and its Microscopic origin? So far all studies have ignored the possibility that the glass production techniques may be obscuring the validity of any such comparisons.
Author
Glass; Temperature Measurement; Specific Heat; Dynamic Characteristics; Temperature Dependence; Crystals

20010057330 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; Microgravity Materials Science Conference 2000; March 2001; Volume 3, pp. 630-636; In English; See also 20010057302; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A02, Hardcopy

Experimental investigations of undercooled rare earth aluminate liquids have revealed scientifically and technologically interesting properties. These liquids can be deeply undercooled under containerless conditions. The liquids are highly fragile,

evidenced by highly non-Arrhenian viscosity vs temperature and a large heat capacity relative to the crystalline solids. A liquid-liquid phase transition has been demonstrated over a wide range of chemical compositions and it has been demonstrated that this polyamorphism is suppressed if the liquid contains small amounts of the larger rare earth ions such as La(3+) and Nd(3+). It has also been demonstrated that the ambient oxygen partial pressure has a significant influence on the behavior of undercooled aluminate liquids, and on the liquid structure. Bulk glass can be formed at the cooling rates achieved in containerless experiments and glass fibers can be pulled from the viscous undercooled melts. These glass materials have photonic applications based on the lasing properties of rare earth ions. Crystalline materials formed from the liquid or by crystallization of the glass materials have potential high temperature structural applications based on their highly refractory, oxidation resistant, and creep properties. The goal of this investigation is to perform microgravity experiments to determine the mechanism of the polyamorphic phase transition and obtain highly accurate viscosity versus temperature results to characterize the fragile liquid behavior. The approach is to determine the kinetics of the liquid-liquid phase transition an measure viscosities over a wide range of temperatures using the oscillating drop technique in the low viscosity (under-damped) regime and drop relaxation measurements in the higher viscosity (over-damped) regime. The prototype material composition is Y3A15O12, with potential variations in Y:Al and rare-earth dopants that extend the temperature range in which polyamorphism can be observed, or avoided in the viscosity measurements. Control of the oxygen activities in the liquid is required. The microgravity investigation is motivated by the facts that containerless conditions are required in the research and the phase transition kinetics cannot be accurately measured in earth-based experiments. Levitator-induced fluid motion, convection, stirring, and gravity-induced sedimentation mixes the two liquids, masks progress of the phase transition, and prevents control of the dissolved oxygen activity when the sample temperatures are changed. The experiments are designed to exploit the high degree of mechanical, thermal, and chemical quiescence that can be achieved under microgravity conditions.

Author

Microgravity; Liquid-Liquid Interfaces; Aluminates; Yttrium Oxides; Cooling; Melts (Crystal Growth)

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Phase Separation and Self-Assembly of Liquid Crystals and Polymer Dispersions: A Ground-Based Feasibility Study for Microgravity

Whitehead, Joe B., Jr., University of Southern Mississippi, USA; Crawford, Gregory P., Brown Univ., USA; Microgravity Materials Science Conference 2000; March 2001; Volume 3, pp. 637; In English; See also 20010057302; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: Issuing Activity; Abstract Only

Polymer dispersed liquid crystals (PDLC) provide a unique opportunity to systematically study phase separation and microstructure development in terrestrial and microgravity environments. The microstructure or morphology of PDLC materials depends on concentration, viscosity, curing temperature, mechanism of phase separation, sample thickness, and gravitational effects. PDLC materials are fabricated using Polymerization Induced Phase Separation (PIPS), Solvent Induced Phase Separation (SIPS), and Thermally Induced Phase Separation (TIPS). Polymer dispersed liquid crystals, sometimes known as liquid crystal and polymer dispersions, are promising new materials for anti-reflective coatings, omni-directional reflectors, electrically switchable Bragg gratings, spatial light modulators, optical interconnects, optical data storage, dynamically variable lenses, and high intensity laser radiation attenuators. The microstructure of PDLC materials range from liquid crystal droplets dispersed in solid polymer matrix, commonly known as the 'Swiss cheese' morphology, to alternating liquid crystal droplet and polymer planes, and to a polymeric membrane suspended in the liquid crystal solvent. We propose a systematic study of polymerization induced phase separation of liquid crystal and polymer dispersions to elucidate the relationship between the process control parameters and the resultant PDLC morphology in the terrestrial environment, and to facilitate the design of a future reduced gravity investigation. The knowledge gained during the ground-based study is immediately applicable to enhancing the properties of current PDLCs. The ground-based study will include: (1) the development of phase diagrams for liquid crystal/prepolymer and/or monomer mixtures; scanning electron microscopy, and electro-optic measurements; and (3) real-time characterization of PDLC microstructure evolution using laser light scattering. The results of the ground-based studies will determine the design of the reduced gravity flight activities. The goal of the project is an enhanced understanding of phase separation processes. The results are applicable to the production of benchmark PDLCs and to the understanding of fluid flow in complex fluids under varying gravitational conditions.

Author

Phase Diagrams; Prepolymers; Dispersion; Gravitational Effects; Microgravity; Ground Based Control; Liquid Crystals

20010057583 NASA Langley Research Center, Hampton, VA USA

Reflective and Electrically Conductive Surface Silvered Polyimide Films and Coatings Prepared via Unusual Single-Stage Self-Metallization Techniques

Southward, Robin E., NASA Langley Research Center, USA; Stoakley, Diane M., NASA Langley Research Center, USA; Progress in Organic Coatings; 2001; ISSN 0300-9440; Volume 41, pp. 99-119; In English; Copyright; Avail: Issuing Activity

Highly reflective and/or surface conductive flexible polyimide films can be prepared by the incorporation of positive valent silver compounds into solutions of poly(amic acid)s formed from a variety of dianhydrides and diamines. Thermal curing of selected silver(I)-containing poly(amic acid)s leads to cycloimidization of the polyimide precursor with concomitant silver(I) reduction and surface aggregation of the metal yielding a reflective and/or conductive silver surface similar to that of the native metal. However, not all silver(I) precursors are effective surface metallization agents and not all poly(amic acid)s metallize with equal facility. Ligand/anion and polyimide structural effects on film metallization efficacy and on physical properties on metallized films are reviewed.

Author

Polyimides; Silver; Metal Films; Metallizing; Silver Compounds; Electrical Resistivity

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Roles of Poly(propylene glycol) During Solvent-Based Lamination of Ceramic Green Tapes

Suppakarn, Nitinat, Case Western Reserve Univ., USA; Ishida, Hatsuo, Case Western Reserve Univ., USA; Cawley, James D., Case Western Reserve Univ., USA; [2000]; 27p; In English

Contract(s)/Grant(s): NCC3-404; RTOP 523-31-13; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Solvent lamination for alumina green tapes is readily accomplished using a mixture of ethanol, toluene and poly(propylene glycol). After lamination, the PPG is clearly present as a discrete film at the interface between the laminated tapes. This condition, however, does not generate delamination during firing. Systematic sets of experiments are undertaken to determine the role of PPG in the lamination process and, specifically, the mechanism by which it is redistributed during subsequent processing. PPG slowly diffuses through the organic binder film at room temperature. The PPG diffusion rapidly increases as temperature is increased to 80 C. The key to the efficiency of adhesives during green-tape lamination is mutual solubility of the nonvolatile component of the glue and the base polymeric binder.

Author

Glycols; Ceramics; Delaminating; Solvents; Laminates

20010058721 Los Alamos National Lab., NM USA

Plasma Sprayed Functionally Graded and Layered MoSi2-Al2O3 Composites for High Temperature Sensor Sheath Applications

Vaidya, R. U.; Castro, R. G.; Gallegos, D. E.; Petrovic, J. J.; 2001; 16p; In English; Original contains color illustrations

Report No.(s): PB2001-106087; No Copyright; Avail: National Technical Information Service (NTIS)

Protective sensor sheaths are required in the glass industry for sensors that are used to measure various properties of the melt. Molten glass presents an extremely corrosive elevated temperature environment, in which only a few types of materials can survive. Molybdenum disilicide (MoSi2) has been shown to possess excellent corrosion resistance in molten glass, and is thus a candidate material for advanced sensor sheath applications. Plasma spray-forming techniques were developed to fabricate molybdenum dilicide-alumina (Al2O3) laminate and functionally graded composite tubes with mechanical properties suitable for sensor sheath applications. These functionally graded materials (FGMs) were achieved by manipulating the powder hoppers and plasma torch translation via in-house created computer software. Molybdenum disilicide and alumina are thermodynamically stable elevated temperature materials with closely matching thermal expansion coefficients. Proper tailoring of the microstructure of these MoSi2-Al2O3 composites can result in improved strength, toughness, and thermal shock resistance. This study focuses on the mechanical performance of these composite microstructures.

NTIS

Temperature Sensors; Composite Structures; Glass; Plasma Sheaths

20010058870 FROM

Performance of a Polymer Sealant Coating in an Arctic Marine Environment

2001; 14p; In English

Report No.(s): PB2001-105608; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The feasibility of using a polymer-based coating, Polibrid 705, to seal concrete and steel surfaces from permanent radioactive contamination in an Arctic marine environment has been successfully demonstrated using a combination of field and laboratory

testing. A mobile, self-sufficient spraying device was developed to specifications provided by the Russian Northern Navy and deployed at the RTP Atomflot site, Murmansk, Russia. Demonstration coatings were applied to concrete surfaces exposed to conditions ranging from indoor pedestrian usage to heavy vehicle passage and container handling in a loading dock. A large steel container was also coated with the polymer, filled with solid radwaste, sealed, and left out of doors, exposed to the full annual Arctic weather cycle. The 12 months of field testing gave rise to little degradation of the sealant coating, except for a few chips and gouge marks on the loading bay surface that were readily repaired. Contamination resulting from radwaste handling was easily removed and the surface was not degraded by contact with the decontamination agents. The field tests were accompanied by a series of laboratory qualification tests carried out at a research laboratory in St. Petersburg. The laboratory tests examined a variety of properties, including bond strength between the coating and the substrate, thermal cycling resistance, wear resistance, flammability, and ease of decontamination. The Polibrid 705 coating met all the Russian Navy qualification requirements with the exception of flammability. In this last instance, it was decided to restrict application of the coating to land-based facilities.
NTIS
Coatings; Performance Tests; Sealers; Radioactive Contaminants

20010059036 NASA Lewis Research Center, Cleveland, OH USA
Environmental Effects on Non-oxide Ceramics
Jacobson, Nathan S., NASA Lewis Research Center, USA; Opila, Elizabeth J., NASA Lewis Research Center, USA; [1997]; 80p; In English
Contract(s)/Grant(s): RTOP 537-04-22; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

Non-oxide ceramics such as silicon carbide (SiC) and silicon nitride (Si3N4) are promising materials for a wide range of high temperature applications. These include such diverse applications as components for heat engines, high temperature electronics, and re-entry shields for space vehicles. Table I lists a number of selected applications. Most of the emphasis here will be on SiC and Si3N4. Where appropriate, other non-oxide materials such as aluminum nitride (AlN) and boron nitride (BN) will be discussed. Proposed materials include both monolithic ceramics and composites. Composites are treated in more detail elsewhere in this volume, however, many of the oxidation/corrosion reactions discussed here can be extended to composites. In application these materials will be exposed to a wide variety of environments. Table I also lists reactive components of these environments.It is well-known that SiC and Si3N4 retain their strength to high temperatures. Thus these materials have been proposed for a variety of hot-gas-path components in combustion applications. These include heat exchanger tubes, combustor liners, and porous filters for coal combustion products. All combustion gases contain CO2, CO, H2, H2O, O2, and N2. The exact gas composition is dependent on the fuel to air ratio or equivalence ratio. (Equivalence ratio (EQ) is a fuel-to-air ratio, with total hydrocarbon content normalized to the amount of O2 and defined by EQ=1 for complete combustion to CO2 and H2O). Figure 1 is a plot of equilibrium gas composition vs. equivalence ratio. Note that as a general rule, all combustion atmospheres are about 10% water vapor and 10% CO2. The amounts of CO, H2, and O2 are highly dependent on equivalence ratio.
Author
Ceramics; Silicon Carbides; Silicon Nitrides; Carbon Dioxide; Combustion Products; Environment Effects; Equivalence; High Temperature Gases

20010059183 National Inst. of Standards and Technology, Materials Science and Engineering Lab., Gaithersburg, MD USA
Polymers Division FY 2000 Programs and Accomplishments
Jan. 2001; 98p; In English
Report No.(s): PB2001-102782; NISTIR-6596; No Copyright; Avail: CASI; A02, Microfiche; A05, Hardcopy

The Division undertook a major structural reorganization during the past year in order to respond to a changing research environment and to anticipate evolving priorities. Similar to trends in academic centers and industrial laboratories our new organizational structure features project teams that form and dissolve in response to needs and opportunities. The organization of the annual report is also different this year. The new style highlights the motivation for the work and it also allows us to explain some of the technical issues. The Division's work is presented as project updates from continuing projects and reports on completed projects.
NTIS
Polymer Blends; Composite Materials; Polymers

20010059295 NASA Langley Research Center, Hampton, VA USA

Crosslink Density and Molecular Weight Effects on the Viscoelastic Response of a Glassy High-Performance Polyimide

Nicholson, Lee M., Institute for Computer Applications in Science and Engineering, USA; Whitley, Karen S., NASA Langley Research Center, USA; Gates, Thomas S., NASA Langley Research Center, USA; [2001]; 2p; In English; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

Durability and long-term performance are among the primary concerns for the use of advanced polymer matrix composites (PMCs) in modern aerospace structural applications. For a PMC subJected to long-term exposure at elevated temperatures. the viscoelastic nature of the polymer matrix will contribute to macroscopic changes in composite stiffness, strength and fatigue life. Over time. changes in the polymer due to physical aging will have profound effects on tile viscoelastic compliance of the material, hence affecting its long-term durability. Thus, the ability to predict material performance using intrinsic properties, such as crosslink density and molecular weight, would greatly enhance the efficiency of design and development of PMCs. The objective of this paper is to discuss and present the results of an experimental study that considers the effects of crosslink density, molecular weight and temperature on the viscoelastic behavior including physical aging of an advanced polymer. Five distinct variations in crosslink density were used to evaluate the differences in mechanical performance of an advanced polyimide. The physical aging behavior was isolated by conducting sequenced, short-term isothermal creep compliance tests in tension. These tests were performed over a range of sub-glass transition temperatures. The material constants, material master curves and physical aging-related parameters were evaluated as a function of temperature crosslink density and molecular weight using time-temperature and time-aging time superposition techniques.

Author

Density (Mass/Volume); Molecular Weight; Viscoelasticity; Glass; Polyimides; Time Temperature Parameter; Service Life; Composite Materials

20010059328 National Taiwan Univ., Center for Condensed Matter Sciences, Taipei, Taiwan, Province of China

Design and Synthesis of Starburst Conjugated Polymer toward Preparation of Conductive Elastomers ***Final Report***

Chiang, Long Y., National Taiwan Univ., Taiwan, Province of China; Mar. 27, 2001; 35p; In English

Contract(s)/Grant(s): F62562-99-M-9211; F62562-99-Q-1599

Report No.(s): AD-A388652; AOARD-994007; No Copyright; Avail: CASI; A01, Microfiche; A03, Hardcopy

This report results from a contract tasking National Taiwan University as follows: The contractor will investigate the area of Conducting Elastomers for Gap Treatment with respect to the low-observable maintenance of B-2 and F-22 aircraft.

DTIC

Elastomers; Polymers; Composite Materials; Aircraft Construction Materials

20010059374 NASA Glenn Research Center, Cleveland, OH USA

Progress on BN and Doped-BN Coatings on Woven Fabrics

Hurwitz, Frances I., NASA Glenn Research Center, USA; Scott, John M., Refractory Composites, Inc., USA; Chayka, Paul V., ATMI, Inc., USA; [2001]; 8p; In English; 25th Annual International Conference on Advanced Ceramics and Composites, USA; Sponsored by American Ceramic Society, USA

Contract(s)/Grant(s): RTOP 708-90-43; NASA Order C-70886-K; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

A novel, multistep process for applying interface coatings to woven structures using a pulsed CVD process is being evaluated. Borazine (B3N3H6), a neat liquid, and several Si precursors are used in the process to produce BN and SiBN coatings on Hi-Nicalon fabrics and preforms. A three variable, two level, full factorial matrix is proposed to define the influence of processing parameters. Coating morphology, uniformity and chemistry are characterized by field emission scanning electron microscopy (FESEM), energy dispersive (EDS) and Auger spectroscopies.

Author

Coating; Doped Crystals; Fabrics; Morphology; Vapor Deposition; Coatings; Boron Nitrides; Fibers

20010059599 NASA Glenn Research Center, Cleveland, OH USA

Transient Reliability of Ceramic Structures

Jadaan, Osama, Wisconsin Univ., USA; Nemeth, Noel, NASA Glenn Research Center, USA; [2001]; 2p; In English

Contract(s)/Grant(s): DE-A101-97EE-50464; NAG3-2242; RTOP 708-31-13; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

Present capabilities of the NASA CARES/Life code include probabilistic life prediction of ceramic components subjected to fast fracture, slow crack growth (SCG) (stress corrosion), and cyclic fatigue failure modes. Currently, this code has the capability to compute the time-dependent reliability of ceramic structures subjected to simple time-dependent loading. For

example, in SCG type failure conditions CARES/Life can handle the cases of sustained and linearly increasing time-dependent loads, while for cyclic fatigue applications, it can account for various types of repetitive constant amplitude loads. In real applications applied loads are rarely that simple, but rather vary with time in more complex ways such as engine start up and shut down and dynamic and vibrational loads. In addition, when a given component is subjected to transient environmental and/or thermal conditions, the material properties also vary with time. The objective of this paper is to demonstrate a methodology capable of predicting the time-dependent reliability of components subjected to transient thermomechanical loads that take into account the change in material response with time. In this paper, the dominant delayed failure mechanism is assumed to be SCG, This capability has been added to the NASA CARES/Life (Ceramic Analysis and Reliability Evaluation of Structures/Life) code, which has also been modified to have the ability of interfacing with commercially available finite element analysis (FEA) codes executed for transient load histories. An example involving a ceramic exhaust valve subjected to combustion cycle loads is presented to demonstrate the viability of this methodology and the CARES/Life program.
Author
Ceramics; Crack Propagation; Failure Modes; Life (Durability); Predictions; Applications Programs (Computers)

20010059862 NASA Glenn Research Center, Cleveland, OH USA
Structure-Property Relationship in High Tg Thermosetting Polyimides
Chuang, Kathy C., NASA Glenn Research Center, USA; Meador, Mary Ann B., NASA Glenn Research Center, USA; HardyGreen, DeNise, Akron Univ., USA; [2000]; 14p; In English; Polycondensation 2000, 18-21 Sep. 2000, Tokyo, Japan
Contract(s)/Grant(s): RTOP 523-31-13; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This viewgraph presentation gives an overview of the structure-property relationship in high glass transition temperatures (T(sub g)) thermosetting polyimides. The objectives of this work are to replace MDA in PMR-15 with 2,2-substituted benzidine and to evaluate the thermo-oxidative stability and mechanical properties of DMBZ-15 against PMR-15. Details are given on the T(sub g) of polyimide resins, the x-ray crystal structure of 2,2-Bis(trifluoro)benzidine (BFBZ), the isothermal aging of polyimide resins at 288 C under 1 atm of circulating air, the compressive strength of polyimide composites, and a gas evaluation profile of DMBZ-15 polyimide resins.
CASI
Crystal Structure; Isothermal Processes; Mechanical Properties; Polyimide Resins

20010059874 Guigne International Ltd., Paradise, Newfoundland Canada
Gravity Effects on Combustion Synthesis of Glasses
Yi, H. C., Guigne International Ltd., Canada; Guigne, J. Y., Guigne International Ltd., Canada; Moore, J. J., Colorado School of Mines, USA; Robinson, L. A., Guigne International Ltd., Canada; Manerbino, A. R., Guigne International Ltd., Canada; Schowengerdt, F. D., Colorado School of Mines, USA; [2000]; 8p; In English; First International Symposium on Microgravity Research Applications in Physical Science and Biotechnology, 10-15 Sep. 2000, Sorrento, Italy
Contract(s)/Grant(s): NCC3-659; RTOP 101-12-0A; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The Combustion Synthesis technique has been used to produce glasses based on B2O3-Al2O3-MgO and CaO-Al2O3. The combustion characteristics of these combustion synthesis reactions using both small cylindrical pellets (SCP) and large spherical pellets (LSP) are presented. Low density pellets (approx. 35% of their theoretical density) were used, which made synthesis of low exothermic combustion reactions possible. Microstructural analysis of reacted samples was carried out to identify the glass-forming compositions. The effects of gravity on the glass formation were studied aboard the KC-135 using SCP samples. Gravity seemed to have such obvious effects on the combustion characteristics that the wave velocity was lower and the Width of the combustion wave was larger under reduced gravity conditions. Samples produced under low gravity also had more enhanced vitrification than those on ground, while some systems also exhibited lower combustion temperatures. It was also found that the container significantly affects both the combustion characteristics and microstructure. Substantially more divitrification occurred at the area which was in contact with the support (container).
Author
Gravitational Effects; Glass; Combustion Synthesis; Aluminum Oxides; Microgravity; Combustion Temperature; Pellets

28
PROPELLANTS AND FUELS

Includes rocket propellants, igniters and oxidizers; their storage and handling procedures; and aircraft fuels. For nuclear fuels see 73 Nuclear Physics. For related information see also 07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power, and 44 Energy Production and Conversion.

20010056602 NASA Kennedy Space Center, Cocoa Beach, FL USA
Reducing/Eliminating ESD Hazards During Pyro Operations
Soriano, Jose Francisco, NASA Kennedy Space Center, USA; June 2001; 42p; In English; Original contains color illustrations
Report No.(s): NASA/TM-2001-210256; NAS 1.15:210256; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Several safety concerns have occurred during pyro operations at 30% or lower RH in the OPF area based on the increase of electrostatic discharge (ESD). These concerns targeted the safety of personnel, flight hardware, and ground support equipment (GSE). Two proposed methods considered to control ESDs during pyro operations at 30% or lower RH are the use of an ionizer blower and to increase the moisture content. In order to demonstrate that the ionizer is effective in neutralizing static charge, a series of experimental runs were conducted in the Electrostatics Laboratory located in the Operations & Checkout (O&C) Building at NASA Kennedy Space Center (KSC). The effectiveness of the ionizer blower was evaluated based upon the time lapse of a charged metal plate from initial 1000 to 400 volts. Distance, RH, and angle of attack were studied. A full factorial experiment (2(exp 3) = 8) was conducted. Since we did not have a statistical analysis program, such as SAS, available, calculations were done manually based on the method of ANOVA (Analysis of Variances), but R(exp 2) (fitness of curve) was not obtained. As conjectured, distance was found to be the major influencial variable. Therefore, we concluded that the best possible combination of situations would be to position the ionizer blower as close as possible and facing directly into the charged plate. This scenario resulted in the quickest discharge rate, which would be the most beneficial during pyro operations below 30% RH. The second method of increasing the moisture content in the work environment through a modification of the OPF ECS current configuration appeared to be dependent on budget constraints and currently not planned to be modified. Finally, some recommendations are discussed such as to test the ionizer in an actual field experiment with a mockup pyro connector and a technician with all the NASA KSC Safety-compliant PPE to assess the realistic effectiveness of the ionizer blower.
Author
Electrostatics; Electric Discharges; Pyrotechnics; Ionizers; Blowers

20010059184 Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA USA
Gulf of Mexico Outer Continental Shelf Daily Oil and Gas Production Rate Projections From 2001 Through 2005
Melancon, J. M.; Bongiovani, R.; Baud, R. D.; May 2001; 30p; In English
Report No.(s): PB2001-105926; OCS/MMS-2001-044; No Copyright; Avail: CASI; A01, Microfiche; A03, Hardcopy

This paper provides daily oil and gas production rate projections for the Gulf of Mexico (GOM) Outer Continental Shelf (OCS) for the years 2001 through 2005. These projections represent average daily oil and gas production estimates for each calendar year.
NTIS
Continental Shelves; Gulf of Mexico

20010059608 Johns Hopkins Univ., Chemical Propulsion Information Agency, Columbia, MD USA
Solid Propellant Subscale Burning Rate Test Techniques and Hardware for US and Selected NATO Facilities
Fry, Ronald S., Johns Hopkins Univ., USA; July 2001; 156p; In English
Contract(s)/Grant(s): SPO700-97-D-4004
Report No.(s): CPTR-74; No Copyright; Avail: CPIA, 10630 Little Patuxent Pkwy., Suite 202, Columbia, MD 21044-3200 HC

Current burning rate measurement test techniques and subscale test hardware used within the NATO community are reviewed and recommendations are made to support improved prediction of internal ballistics of a full-scale solid propellant motor. The NATO Research and Technology Organization (RTO), Advanced Vehicle Technology (AVT), Working Group (WG) 016 (formerly AGARD/PEP Working Group #27) undertook to evaluate methods used within the NATO propulsion community to measure burning rate in solid propellant rocket systems. The purpose was to identify similarities and differences among the member nations. The WG 016 sought to contribute to improvements in the burning rate tools by addressing issues that have remained unresolved in the solid propulsion industry for over 40 years: (1) Better understanding of burning rate, r(sub b)(p,T(sub o)), data from various facilities to ease the comparison of propellants from various manufacturers and to improve international exchanges and cooperation. (2) Improved measurement accuracy and reliability to allow a decrease in the number of tests (and associated time and cost) and improved control of manufacturing and quality assurance and the assessment of aging, AVT WG

016 activities have identified that manufacturer burning rate data may not easily be compared without accounting for industry-wide differences in subscale devices, test methods and scaling analysis methods. The WG recommends the NATO propulsion community review these findings as a means of advancing their own burning rate measurement and analysis methods.
Author
Burning Rate; Propellant Tests; Propulsion; Solid Propellant Rocket Engines; Combustion; Combustion Efficiency; Standardization

20010059878 Sandia National Labs., Combustion Research Facility, Livermore, CA USA
Viscous and Thermal Effects on Hydrodynamic Instability in Liquid-Propellant Combustion
Margolis, Stephen B., Sandia National Labs., USA; [2000]; 15p; In English; 38th Aerospace Sciences Meeting and Exhibit, 10-13 Jan. 2000, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Contract(s)/Grant(s): DE-AC04-94AL-85000; NASA Order C-32031-E; RTOP 101-12-0A
Report No.(s): AIAA Paper 2000-0309; Copyright Waived; Avail: CASI; A03, Hardcopy; A01, Microfiche

A pulsating form of hydrodynamic instability has recently been shown to arise during the deflagration of liquid propellants in those parameter regimes where the pressure-dependent burning rate is characterized by a negative pressure sensitivity. This type of instability can coexist with the classical cellular, or Landau, form of hydrodynamic instability, with the occurrence of either dependent on whether the pressure sensitivity is sufficiently large or small in magnitude. For the inviscid problem, it has been shown that when the burning rate is realistically allowed to depend on temperature as well as pressure, that sufficiently large values of the temperature sensitivity relative to the pressure sensitivity causes the pulsating form of hydrodynamic instability to become dominant. In that regime, steady, planar burning becomes intrinsically unstable to pulsating disturbances whose wavenumbers are sufficiently small. In the present work, this analysis is extended to the fully viscous case, where it is shown that although viscosity is stabilizing for intermediate and larger wavenumber perturbations, the intrinsic pulsating instability for small wavenumbers remains. Under these conditions, liquid-propellant combustion is predicted to be characterized by large unsteady cells along the liquid/gas interface.
Author
Burning Rate; Inviscid Flow; Liquid Rocket Propellants; Propellant Combustion; Sensitivity; Mathematical Models

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SPACE PROCESSING

Includes space-based development of materials, compounds, and processes for research or commercial application. Also includes the development of materials and compounds in simulated reduced-gravity environments. For legal aspects of space commercialization see 84 Law, Political Science and Space Policy.

20010056301 NASA Marshall Space Flight Center, Huntsville, AL USA
NASA's Microgravity Research Program *Annual Report, FY 1999*
[2000]; 77p; In English
Report No.(s): NASA/TM-2000-210615; NAS 1.15:210615; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

This fiscal year (FY) 1999 report describes key elements of the NASA Microgravity Research program (MRP) as conducted by the Microgravity Research Division (MRD) within NASA's Office of Life and Microgravity Sciences and Applications. The program's goals approach taken to achieve those goals, and available resources are summarized. A snapshot of the program's status it the end of FY 1999 and a review of highlights and progress in ground- and flight-based research are provided. Also described are major space missions that flew during FY 1999, plans for utilization of the research potential of the International Space Station, technology development, and various education and outreach activities. The MRP supports investigators from academia, industry, and government research communities needing a space environment to study phenomena directly or indirectly affected by gravity.
Derived from text
Microgravity; Space Missions; Spaceborne Experiments; NASA Programs; Education

20010057241 NASA Marshall Space Flight Center, Huntsville, AL USA
Exploiting the Temperature Dependence of Magnetic Susceptibility to Control Convective in Fundamental Studies of Solidification Phenomena
Seybert, C., California Univ., USA; Evans, J. W., California Univ., USA; Leslie, F., NASA Marshall Space Flight Center, USA; Jones, W. K., Jr., Motorola, Inc., USA; Microgravity Materials Science Conference 2000; March 2001; Volume 1, pp. 213-215;

In English; See also 20010057199; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A01, Hardcopy

It is well known that convection is a dominant mass transport mechanism when materials are solidified on Earth's surface. This convection is caused by gradients in density (and therefore gravitational force) that are brought about by gradients in temperature, composition or both. Diffusion of solute is therefore dwarfed by convection and the study of fundamental parameters, such as dendrite tip shape and growth velocity in the absence of convection is nearly impossible. Significant experimental work has therefore been carried out in orbiting laboratories with the intent of minimizing convection by minimizing gravity. One of the best known experiments of this kind is the Isothermal Dendritic Growth Experiment (IDGE), supported by NASA. Naturally such experiments are costly and one objective of the present investigation is to develop an experimental method whereby convection can be halted, in solidification and other experiments, on the Earth's surface. A second objective is to use the method to minimize convection resulting from the residual accelerations suffered by experiments in microgravity.

Derived from text

Convection; Crystal Growth; Magnetic Permeability; Microgravity; Solidification; Temperature Dependence

20010057280 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; Microgravity Materials Science Conference 2000; March 2001; Volume 2, pp. 382-387; In English; See also 20010057256; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A02, Hardcopy

Mathematical models are developed to represent the complex electrodynamic and hydrodynamic phenomena in magnetically and electrostatically levitated droplets in microgravity environment. The numerical model development is 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. The models are applied to address the following key issues concerning the behavior of magnetically and electrostatically positioned droplets in space: (1) electromagnetically or electrostatically induced surface deformation, (2) internal flows driven by electromagnetic forces or surface tension, (3) viscous surface oscillation and heat transfer of droplets levitated magnetically, and (4) turbulent flow behavior in magnetically-levitated droplets.

Author

Electrostatics; Levitation; Mathematical Models; Microgravity; Magnetic Suspension

20010057281 NASA Lewis Research Center, Cleveland, OH USA

Study of Magnetic Damping Effect on Convection and Solidification Under G-Jitter Conditions

Li, Ben Q., Washington State Univ., USA; deGroh, H. C., NASA Lewis Research Center, USA; Microgravity Materials Science Conference 2000; March 2001; Volume 2, pp. 388-393; In English; See also 20010057256; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A02, Hardcopy

As shown in space flight experiments, g-jitter is a critical issue affecting solidification processing of materials in microgravity. 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. Analytical solutions and 2-D and 3-D numerical models for g-jitter driven flows in simple solidification systems with and without the presence of an applied magnetic field have been developed and extensive analyses were carried out. A physical model was also constructed and PIV measurements compared reasonably well with predictions from numerical models. 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 oscillates at approximately 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 developing numerical models for solidification phenomena with the presence of both g-jitter and magnetic fields and developing a ground-based physical model to verify numerical predictions.

Author

Microgravity; Solidification; Mathematical Models; Magnetic Fields; Convection; Vibration Damping

20010057298 Wisconsin Univ., Dept. of Materials Science and Engineering, Madison, WI USA

Analysis of Containerless Solidification Microstructures in Undercooled Melts and Composite Systems

Perepezko, J. H., Wisconsin Univ., USA; Microgravity Materials Science Conference 2000; March 2001; Volume 2, pp. 458-464; In English; See also 20010057256; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A02, Hardcopy

The main research objective is the evaluation and analysis of the undercooling and resultant solidification microstructures in containerless processing, including drop tube processing and levitation melt processing of selected alloys and composites. The results are intended for use as an experience base for the design of space-based microgravity experiments. Containerless processing in ground-based drop tubes simulates microgravity conditions via solidification of liquid samples under free fall conditions. The containerless environment is also attained in levitation melt processing and removes a major source of impurities and heterogeneous nucleation sites, allowing for a large melt undercooling. This enhanced liquid undercooling exposes alternate solidification pathways, allowing for the formation of novel microstructures. Controlling the undercooling level provides some control of the operative solidification pathway and the resultant microstructure. The novel structures that may be produced in a ground-based containerless processing facility preview the wide range of possible materials processing experiments that may be conducted in a space-based laboratory. The results of the ground based study will be used to identify critical experimental variables in microgravity processing and the analysis can be used to design and define the science and hardware requirements for extended duration space experiments.

Author

Melts (Crystal Growth); Microgravity; Nucleation; Solidification; Space Processing; Supercooling; Drop Towers; Experiment Design; Microstructure; Levitation Melting

20010057311 University of Southern California, Dept. of Aerospace and Mechanical Engineering, Los Angeles, CA USA

Non-Intrusive Measurement of Thermophysical Properties of Liquids by Electrostatic-Acoustic Hybrid Levitation

Sadhal, Satwindar S., University of Southern California, USA; Ohsaka, Kinichi, University of Southern California, USA; Microgravity Materials Science Conference 2000; March 2001; Volume 3, pp. 519-524; In English; See also 20010057302; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A02, Hardcopy

Ground-based experimental and analytical studies to rigorously validate existing techniques and to develop new approaches for measuring the thermophysical properties of liquids in a containerless environment are being carried out. The important application here is towards understanding the thermal behavior of liquids in undercooled states that can be achieved in microgravity or other containerless environments. The measurement of properties in such a state is particularly difficult because any physical intrusion can lead to instantaneous solidification, thus destroying the undercooled state. The focus of the effort here will be on the rigorous evaluation of the effects of the levitation fields on the liquid samples under scrutiny. Such effects induce equilibrium drop shape deformation, uncontrolled rotation, significant internal flows, and dynamic shape instability. We are also aiming to develop measurement techniques that can be employed while maintaining minimal disturbance levels to the liquid samples. As such, electrostatic and acoustic levitation has shown considerable promise, and this technique will mature to a point of high accuracy. The focus of the measurements will be on density, surface tension, viscosity, and thermal diffusivity of levitated liquid drops. For the thermal property measurement, the methods consist of applying a thermal stimulus to a levitated liquid sample and measuring the response from which the thermophysical proper-ties can be inferred. Viscosity and surface tension measurements will be carried out by observing the response of initially deformed drops (acoustically and electrostatically) to more spherical shapes upon relaxation of the deforming force fields. by using the hybrid levitation approach we plan to quantitatively evaluate the effects of surface charge on the measurement of surface tension and viscosity, the influence of thermocapillary flows on the shape oscillation dynamics and frequencies, and the impact of oscillation mode coupling on the measurement of thermophysical properties. Considerable analytical work will be directly tied in with the measurements because much of the experimentation will be conducted in 1-g where the disturbances from the acoustic and electrostatic fields will need to be accounted for. Therefore, the thermal and the fluid phenomena associated with the local heating of acoustically and electrostatically levitated drops need to be thoroughly understood. In addition, the thermal and flow measurement techniques that have been established in prior studies need to be refined to make them sufficiently non-intrusive and applicable to undercooled liquids.

Author

Acoustic Levitation; Electrostatics; Liquids; Microgravity; Nonintrusive Measurement; Temperature Effects; Thermocapillary Migration; Thermophysical Properties; Capillary Flow; Internal Flow

20010057331 Clarkson Univ., International Center for Gravity, Materials Science and Applications, Potsdam, NY USA

Residual Gas Effects on Detached Solidification in Microgravity

Regel, Liya L., Clarkson Univ., USA; Wilcox, William R., Clarkson Univ., USA; Microgravity Materials Science Conference 2000; March 2001; Volume 3, pp. 638-642; In English; See also 20010057302; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A01, Hardcopy

Detached solidification has been observed in many microgravity experiments. When it occurred, the perfection of the resulting crystals was greatly increased, making them much more useful for electronic and opto-electronic devices. Although detachment has been common, it has also been non-reproducible and erratic, for unknown reasons. Our long term goal is to make it reproducible, which requires a full understanding of the mechanisms underlying it.

Derived from text

Residual Gas; Solidification; Microgravity; Liquid Metals; Boron; Cadmium Tellurides; Carbon; Crystal Growth

20010057335 Cornell Univ., Sibley School of Mechanical and Aerospace Engineering, Ithaca, NY USA

On the Control of the Effects of Gravity on Solidification Microstructures Using Optimally Designed Boundary Heat Fluxes and Electromagnetic Fields

Zabaras, Nicholas, Cornell Univ., USA; Sampath, Rajiv, Cornell Univ., USA; Microgravity Materials Science Conference 2000; March 2001; Volume 3, pp. 658-663; In English; See also 20010057302; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A02, Hardcopy

The main objective of this work is to design and test computational techniques that can be used to control the microstructures that are developed during directional solidification processes. Gravity plays an important role in the obtained microstructures mainly by influencing the melt flow mechanisms as well as the solute diffusion processes. Since these effects remain present even under a reduced gravity environment, we address inverse design solidification problems that result in desired microstructures at various gravity levels. Our main design variables are the thermal mold/furnace conditions as well as the strength and orientation of an externally applied electromagnetic field. We select these continuous variables such that a desired growth velocity and temperature gradient are achieved near the freezing interface that correspond to desired microstructures. In our preliminary work, we are interested to design processes with spatially uniform growth velocity under stable growth conditions.

Derived from text

Gravitational Effects; Solidification; Microstructure; Boundary Conditions; Heat Flux; Electromagnetic Fields; Performance Tests; Directional Solidification (Crystals)

20010057337 Alabama Univ., Center for Microgravity and Materials Research, Huntsville, AL USA

Ground Based Experiments in Support of Microgravity Research Results-Vapor Growth of Organic Nonlinear Optical Thin Film

Zugrav, M. Ittu, Alabama Univ., USA; Carswell, William E., Alabama Univ., USA; Haulenbeek, Glen B., Alabama Univ., USA; Wessling, Francis C., Alabama Univ., USA; Microgravity Materials Science Conference 2000; March 2001; Volume 3, pp. 666-671; In English; See also 20010057302; CD-ROM contains the entire Conference Proceedings presented in PDF format

Contract(s)/Grant(s): NAG8-1456; No Copyright; Avail: CASI; A02, Hardcopy

This work is specifically focused on explaining previous results obtained for the crystal growth of an organic material in a reduced gravity environment. On STS-59, in April 1994, two experiments were conducted with N,N-dimethyl-p-(2,2-dicyanovinyl) aniline (DCVA), a promising nonlinear optical (NLO) material. The space experiments were set to reproduce laboratory experiments that yielded small, bulk crystals of DCVA. The results of the flight experiment, however, were surprising. Rather than producing a bulk single crystal, the result was the production of two high quality, single crystalline thin films. This result was even more intriguing when it is considered that thin films are more desirable for NLO applications than are bulk single crystals. Repeated attempts on the ground to reproduce these results were fruitless. A second set of flight experiments was conducted on STS-69 in September 1995. This time eight DCVA experiments were flown, with each of seven experiments containing a slight change from the first reference experiment. The reference experiment was programmed with growth conditions identical to those of the STS-59 mission. The slight variations in each of the other seven were an attempt to understand what particular parameter was responsible for the preference of thin film growth over bulk crystal growth in microgravity. Once again the results were surprising. In all eight cases thin films were grown again, albeit with varying quality. So now we were faced with a phenomenon that not only takes place in microgravity, but also is very robust, resisting all attempts to force the growth of bulk single crystals.

Derived from text

Ground Based Control; Microgravity; Vapor Deposition; Crystal Growth; Thin Films; Optical Materials; Nonlinearity

31
ENGINEERING (GENERAL)

Includes general research topics to engineering and applied physics, and particular areas of vacuum technology, industrial engineering, cryogenics, and fire prevention. For specific topics in engineering see categories 32 through 39.

20010054779 Ljubljana Univ., Fakulteta za Elekrotehniko, Ljubljana, Slovenia
A Machine Vision System for Rotational Positioning and Type Verification of Oil Filters ***Sistem strojnega vida za rotacijsko pozicioniranje in razpoznavanje oljnih filtrov***
Lahajnar, Franci, Ljubljana Univ., Slovenia; Kovacic, Stanislav, Ljubljana Univ., Slovenia; Electrotechnical Review; 2001; ISSN 0013-5852; Volume 68, No. 1, pp. 1-6; In Slovene; Copyright; Avail: Issuing Activity

The paper describes a PC-based machine vision system (MVS) designed for precise positioning and reliable verification of industrial parts. The developed system is an integral part of an automated production line for assembling various types of automobile oil filters, each one having its own visual appearance. For each filter type, the assembly line performs a sequence of specific operations. Therefore, the filter type has to be known and the filter set at a proper position. The required precision for rotational positioning is 0.5 degrees, whereas the precision of object positioning in front of the vision system is 3 mm. The positioning time is limited by the assembling cycle, which is about one filter per two seconds.
Author
Computer Vision; Positioning; Position Sensing; Production Engineering; Manufacturing

20010056401 NASA Langley Research Center, Hampton, VA USA
Fabrication of Molded Magnetic Article
Bryant, Robert G., Inventor, NASA Langley Research Center, USA; Namkung, Min, Inventor, NASA Langley Research Center, USA; Wincheski, Russell A., Inventor, NASA Langley Research Center, USA; Fox, Robert L., Inventor, NASA Langley Research Center, USA; Feb. 20, 2001; 6p; In English; Division of US-Patent-Appl-SN-846505, filed 9 Apr. 1997, which is provisional US-Patent-Appl-SN-015154, filed 10 Apr. 1996
Patent Info.: Filed 11 Feb. 2000; NASA-Case-LAR-15463-2-SB; US-Patent-6,190,589; US-Patent-Appl-SN-504767; US-Patent-Appl-SN-846505; US-Patent-Appl-SN-015154; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

A molded magnetic article and fabrication method are provided. Particles of ferromagnetic material embedded in a polymer binder are molded under heat and pressure into a geometric shape. Each particle is an oblate spheroid having a radius-to-thickness aspect ratio approximately in the range of 15-30. Each oblate spheroid has flattened poles that are substantially in perpendicular alignment to a direction of the molding pressure throughout the geometric shape.
Author
Fabrication; Ferromagnetic Materials; Casting

20010056444 NASA Langley Research Center, Hampton, VA USA
Process for Making Ceramic Mold
Buck, Gregory M., Inventor, NASA Langley Research Center, USA; Vasquez, Peter, Inventor, NASA Langley Research Center, USA; Jan. 30, 2001; 4p; In English; Provisional US-Patent-Appl-SN-059402, filed 19 Sep. 1997
Patent Info.: Filed 17 Sep. 1998; NASA-Case-LAR-15410-1; US-Patent-6,180,034; US-Patent-Appl-SN-162460; US-Patent-Appl-SN-059402; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

An improved process for slip casting molds that can be more economically automated and that also exhibits greater dimensional stability is disclosed. The process involves subjecting an investment pattern, preferably made from wax, to successive cycles of wet-dipping in a slurry of colloidal, silica-based binder and dry powder-coating, or stuccoing with plaster of Paris or calcium sulfate mixtures to produce a multi-layer shell over the pattern. The invention as claimed entails applying a primary and a secondary coating to the investment pattern. At least two wet-dipping on in a primary slurry and dry-stuccoing cycles provide the primary coating, and an additional two wet-dippings and dry-stuccoing cycles provide the secondary, or back-up, coating. The primary and secondary coatings produce a multi-layered shell pattern. The multi-layered shell pattern is placed in a furnace first to cure and harden, and then to vaporize the investment pattern, leaving a detailed, high precision shell mold.
Official Gazette of the U.S. Patent and Trademark Office
Slip Casting; Ceramics; Dipping; Molds

20010059385 General Accounting Office, Washington, DC USA

Environmental Protection: Improved Inspections and Enforcement Would Better Ensure the Safety of Underground Storage Tanks. Report to Congressional Requesters

May 2001; 44p; In English

Report No.(s): PB2001-105458; GAO-01-464; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

In 1984, because of concerns about risks posed from leaking tanks, the Congress established the Underground Storage Tank (UST) program to monitor the more than 2 million tanks active at the time, most of which were located at gas stations across the country. Administered by the Environmental Protection Agency (EPA), the UST program was designed to prevent releases of petroleum and hazardous substances into the environment, detect releases when they occurred, and clean up any contamination from a release. to monitor this large number of tanks, EPA has enlisted states assistance in implementing and enforcing the UST program. Concerned that the tank program is not effectively preventing leaks and that tanks continue to pose risks, Congress asked the General Accounting Office (GAO) to determine (1) whether the tanks regulated by EPA and the states have the required equipment and are being properly operated and maintained, (2) the breadth of EPAs and the states tank inspections and the types of enforcement actions taken, and (3) whether upgraded tanks were still leaking. to address your questions, we obtained information via survey from tank program managers in all 50 states and the District of Columbia.

NTIS

Storage Tanks; Inspection; Evaluation; Environment Protection; Crude Oil; Contamination

32
COMMUNICATIONS AND RADAR

Includes radar; radio, wire, and optical communications; land and global communications; communications theory. 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 and Safety.

20010054775 Jozef Stefan Inst., Odsek za digitalne komunikacije in mreze, Ljubljana, Slovenia

Channel Allocation in Mobile Communication Systems ***Dodeljevanje kanalov v mobilnih komunikacijskih sistemih***

Drcic, Uros, Jozef Stefan Inst., Slovenia; Mohorcic, Mihael, Jozef Stefan Inst., Slovenia; Kandus, Gorazd, Jozef Stefan Inst., Slovenia; Electrotechnical Review; 2001; ISSN 0013-5852; Volume 68, No. 1, pp. 20-26; In Slovene; Copyright; Avail: Issuing Activity

Frequency reuse is the most important concept in current mobile communication systems. It is based on divisioning the entire system coverage into small cells, reduction of transmitting power and implementation of appropriate resource management techniques. Presently, fixed channel allocation (FCA) techniques are the ones that are mostly used for resource management in cellular mobile communication systems. Due to the lack of available frequency spectrum, particularly in urban areas where further increase of system capacity is required, implementation of methods capable of more efficient resource management is inevitable. In this paper, three centralized dynamic channel allocation (DCA) techniques are presented, i.e. FA (First Available), NN (Nearest Neighbor) and MP (Maximum Packing), and their performance is evaluated with respect to the FCA strategy. A detailed comparison of FA and NN techniques and FCA strategy is performed based on results obtained by a computer simulation made with a model developed for performance evaluation of various FCA and DCA schemes. The performance of different channel allocation strategies is measured in terms of blocking probability of new call demands (PI(sub ba)) and handover attempts (P(sub drop) under the increasing average traffic load. The simulation results prove that DCA strategies are superior to the FCA strategy for low and medium traffic load, while for heavy traffic load the FCA strategy gives better results. Finally, the simulation results show that, due to its intrinsic adaptability to variable traffic load, DCA strategies outperform the FCA strategy also when considering non-homogeneous traffic load distribution among cells.

Author

Computerized Simulation; Frequency Distribution; Management Methods; Mobile Communication Systems; Channels (Data Transmission); Channel Capacity

20010054780 Ljubljana Univ., Fakulteta za Elektrotehniko, Ljubljana, Slovenia

Performance Simulation of Telecommunication Protocols Specified in SDL ***Simulacija zmogljivosti telekomunikacijskih protokolov, specificiranih v jeziku SDL***

Hercog, Drago, Ljubljana Univ., Slovenia; Electrotechnical Review; 2001; ISSN 0013-5852; Volume 68, No. 1, pp. 13-19; In Slovene; Copyright; Avail: Issuing Activity

A communication protocol performance is usually evaluated by means of a discrete-event simulation program. In this paper, a methodology for the development of a protocol performance simulator in C is presented. by using an already existing and easily available simulation library as the simulator implementation framework, the methodology is suitable also for those engineers lacking the expert simulation-specific knowledge. The mapping of SDL specifications of the system to be simulated into the simulator based on the Watkins simulation library is the core of the paper. The mapping is defined using the Extended Backus-Naur Formalism. A process oriented simulation model is used. An SDL process is mapped into a process function, with process states being declared within it as an enumerated data type variable state with state names as its values. In the simulation program, signals are globally and timers locally declared as enumerated data types with signal/tinier names as values, and both are instantiated as instantiations of simulation library entity data type. Values transported by a signal are simulated by a data structure pointed to by the entity at tr component. Signal receptions and timer expirations are simulated as entity activations. A signal is transmitted by creating a signal entity with the associated data structure and by Scheduling it for activation. In the entity components phase and event, the signal name and receiving process function are indicated. When the signal is received, data are retrieved and the entity is terminated, A timer is created in the initialization phase of the simulation program as an entity with its phase and event components indicating the process function and timer name. A timer is set by scheduling its entity and reset by passivating it. When the timer expires, its entity is passivated only, A signal reception or timer expiration is saved (put back into the input queue) by inserting its entity into the conditional list. It is discarded by terminating the signal entity and passivating the timer entity, respectively. Although general conclusions cannot be drawn from a single example, it may however be seen that any optimisation step can provide for some kind of efficiency gain.
Author
Protocol (Computers); Timing Devices; C (Programming Language); Computerized Simulation; Control Simulation; Systems Simulation

20010054782 Ljubljana Univ., Fakulteta za Elektrotehniko, Ljubljana, Slovenia
Determination of the Propagation Constant of Waves in a Waveguide Structure by Boundary Integral Equation Technique ***Dolocanje konstante sirjenja valovanja v valovodni strukturi z metodo robnih integralskih enacb***
Bulic, Edi, Ljubljana Univ., Slovenia; Sinigoj, Anton R., Ljubljana Univ., Slovenia; Electrotechnical Review; 2001; ISSN 0013-5852; Volume 68, No. 1, pp. 74-80; In Slovene; Copyright; Avail: Issuing Activity

The paper deals with a method of determination of the frequency dependent complex propagation constant for HEM modes in a lossy waveguide structure consisting of parallel cylinders. The real part of the complex propagation constant is the phase constant and the imaginary part is the attenuation constant. Geometry of the cross-section of a general waveguide structure is shown. The method is based on the full-wave analysis and on boundary integral equation technique in conjunction with the collocation method, The unknowns in these equations are the tangential electric and magnetic field components at the cylinders' boundaries. The integral regions of integral equations are boundary curves of cross-sections of cylinders. The usage of the impedance boundary condition is also provided. It reduces the system of boundary integral equations and consequently simplifies its solution.
Author
Integral Equations; Propagation Modes; Wave Propagation; Waveguides; Boundary Integral Method; Transmission Lines

20010055676 Naval Air Warfare Center, Aircraft Div., Patuxent River, MD USA
Segmenting Polarimetric SAR Images Using Robust Competitive Clustering
Kersten, Paul; Lee, Roger; Jan. 2001; 6p; In English
Report No.(s): AD-A388958; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Polarimetric Synthetic Aperture Radar (POLSAR) Images have great potential for land-use management, provided the images can be efficiently segmented. This paper describes the application of the robust competitive agglomeration (RCA) clustering algorithm to POLSAR images to segment the images. Examples are presented and future efforts are discussed. Polarimetric Synthetic Aperture Radar (POLSAR) Images have great potential for land-use management, provided the images can he efficiently segmented. This paper describes the application of the robust competitive agglomeration (RCA) clustering algorithm to POLSAR images to segment the images. Examples are presented and future efforts are discussed.
DTIC
Agglomeration; Polarimetry; Synthetic Aperture Radar; Algorithms

20010057183 Civil Aeromedical Inst., Oklahoma City, OK USA

Data-Linked Pilot Reply Time On Controller Workload and Communication in a Simulated Terminal Option ***Final Report***

Prinzo, O. Veronika, Civil Aeromedical Inst., USA; May 2001; 26p; In English

Contract(s)/Grant(s): AM-B-98-HRR-516

Report No.(s): DOT/FAA/AM-01/8; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report describes an analysis of air traffic control communication and workload in a simulated terminal radar approach control environment. The objective of this study was to investigate how pilot-to-controller data-link acknowledgment time might affect controller-perceived workload and operational communication. Eight controllers provided air traffic services to simulated arrival aircraft during a moderate-traffic density simulation in which voice radio and data link communications were available. The effect of a delay in downlinked pilot acknowledgment time to controller uplinked messages was the primary variable of interest. Each controller completed the same scenario twice, with the order of presentation counterbalanced. That is, for the first simulation, half the controllers received immediate responses to their data link messages while the other half received pilot acknowledgment time delayed by about 11 seconds. The primary finding was a general, albeit not statistically significant, tendency among controllers towards an increase in subjective workload overall and on individual dimensions of the NASA Task Load Index when the simulation environment supported mixed, rather than immediate pilot responses. The analysis performed on communication measures revealed that controller workload was affected by the communications capability onboard the aircraft but not ghost pilot response type (immediate, delayed). Transmissions to data link-equipped aircraft took longer to complete and contained longer pauses than transmissions to non-data linked aircraft. The mode of communications selected by controllers also influenced workload but ghost pilot response type did not. When controllers used data link, their transmissions took nearly 2 seconds longer to complete than comparable messages sent by voice. When compared with voice radio messages, controllers took longer to formulate and transmit messages over a data link-communications system, but their messages were more accurate and contained fewer message elements. This finding was replicated when messages with courtesies, salutations, and those involved in the initial contact services were removed. Often, the data-link transmissions that contained longer pauses resulted from deliberate actions an the part of the controllers. Longer latencies did not result in a loss of efficiency but reflected innovations on the part of the controllers to optimize performance. For example, by placing data-link messages in a pending status, controllers would communicate with a non-data-link-equipped aircraft. When the data link-equipped aircraft arrived at a transition-point along their filed flight plan (generally approaching a hand-off point or transition altitude or fix), controllers uplinked their already composed messages to those aircraft.

Author

Data Links; Transition Points; Air Traffic Control; Altitude Control; Controllers; Workloads (Psychophysiology); Voice Communication

20010057187 Communications Research Lab., Tokyo, Japan

Wave Summit Course: Modern Millimeter-Wave Technologies ***Wave Summit Kouza: Shin Miriha Gizyutsu***

Teshirogi, Tasuku, Editor, Communications Research Lab., Japan; Yoneyama, Tsukasa, Editor, Communications Research Lab., Japan; [1999]; 318p; In English

Report No.(s): LC-00-111924; ISBN 4-274-90382-6; Copyright; Avail: Issuing Activity

In October 1896, one year after the success of Marconi's wireless telegraphy experiments, Japan started research into wireless telegraphy at the Electrical Technical Laboratory of the Ministry of Communications. The following year, Mr. Matsunosuke Matsushiro found success in his wireless telegraphy experiments. The Radio Research Laboratories, Ministry of Posts and Telecommunications, was established in 1952 after some reorganization of the laboratories researching radio communication technology. The Radio Research Laboratories was renamed the Communications Research Laboratory in 1988 to reflect the change in the environment for research following the privatization of the Nippon Telegraph and Telephone Corporation in Japan. to celebrate 100 years of radio communications, we have spent several years at the Communications Research Laboratory planning and preparing to publish in book from the results of the research so far conducted. Entitled the "Wave Summit Course," it will contain a series of papers on various aspects of radio communications technology and is aimed at students of both the senior and graduate levels, that is, the generation of scientists who will lead the way in the 21 st century. Now the time for publication has arrived. This series consists of seven volumes: 'Satellite Communications,' 'Very Long Baseline lnterferometer,' 'Science of Space Environment,' 'Modern Millimeter-Wave Technologies,' 'Digital Broadcasting,' 'Mobile Communications,' and 'Global Environment Remote Sensing.' We hope that these volumes will be widely read as useful guides to the different fields in which radio waves are used. Finally, I would like to extend my deep gratitude to all those involved in enabling this project to

come to fruition, including the authors, editors, and successive Director-Generals of the CRL and chairpersons of the publications committee, and of course to Ohmsha, Ltd. for their untiring assistance and encouragement.
Derived from text
Millimeter Waves; Telecommunication; Radio Waves; Radio Communication

20010059607 Communications Research Lab., Tokyo, Japan
Wave Summit Course: Science of Space Environment ***Wave Summit Kouza: Uchu Kankyo Kagaku***
Ondoh, Tadanori, Editor, Communications Research Lab., Japan; Marubashi, Katsuhide, Editor, Communications Research Lab., Japan; [2001]; 318p; In English
Report No.(s): LC-00-111926; ISBN 4-274-90384-2; Copyright; Avail: Issuing Activity

As space becomes increasingly important from the utilization standpoint, there is a growing requirement for accurate information regarding the radiation environment which can damage equipment and impair the health of people working in space. of course, technological solutions to such problems are prefered, but these solutions must at the same time be based on a good understanding of the changes that occur in the space environment. Thus, as we expand areas of application that use the space environment, technological systems must be thoroughly grounded in a knowledge of the conditions that will be encountered in the space environment. The earliest recognition that the space environment affects the social life probably came from the practical use of wireless communications which use the reflection of radio waves by the ionosphere. In his first and most famous transatlantic communication experiment in December, 1901, Guglielmo Marconi gave us the starting point for many later successful endeavors in wireless communications. Marconi succeeded in transmitting and receiving LF radio signals from Poldhu in Cornwall, England to St. John's, Newfoundland. This was the first successful experiment on radio wave propagation over a distance of about 4000 km. Even though we know today that the radio waves can propagate over such a long distance through ionospheric reflection, at that time people still had only a very poor knowledge of the ionosphere. A conductive region in the upper atmosphere where the electric current flows had been inferred from changes in the Earth's magnetic field. This was all they knew about the ionosphere at that time. Then in 1902, Oliver Heaviside of Great Britain and the American Arthur E. Kennelly presented a hypothesis that explained the Marconi's propagation experiment. They said that the radio waves were reflected by the layer of high electric conductivity in the upper atmosphere. The ionosphere is created by the ionization of gaseous particles in the upper atmosphere by solar ultraviolet rays. Information on changes in the ionosphere depending on solar activities and seasons is essential to the selection of the frequencies used in communications. Conditions within the ionosphere also change dramatically when solar flares or magnetic storms occur, resulting in anomalous radio wave propagation. In 1928, the Union Radio-Scientifique Internationale (URSI) established an international cooperative service called the Ursigram broadcast. It issues daily reports on solar and geophysical phenomena related to radio communications and also for promotion of radio science. The first Ursigram report was broadcast using a long-wave radio signal from Paris' Eiffel Tower on December 1, 1928. Japan has been involved in this international cooperative service since the early days, and the work is currently being carried on by the Communications Research Laboratory (CRL), Ministry of Posts and Telecommunications. The study of solar and geophysical phenomena promoted by the necessities related to radio wave propagation for the ionospheric communications can thus be credited with being the forerunner to the Science of the Space Environment. Recognizing that utilization of the space environment would rapidly expand, the CRL started the Space Weather Forecasting project in 1988. "Space weather" is a metaphorical expression, likening the space environment to the weather on Earth, especially when human routine activities extend into space. We determined to apply the solar-terrestrial physics, which had been developed as the basis for the effective operation of ionospheric radio communications, to the understanding and prediction of the space environment. Space weather research has become common worldwide. The National Space Weather Program started by the USA in 1993 defines space weather as "conditions on the Sun and in the solar wind, magnetosphere, ionosphere and thermosphere that can influence the performance and reliability of space-borne and ground-based technological systems and can endanger human life or health." The research field aiming at integrated studies of space weather thus defined is now referred to as the Science of the Space Environment. The science of the Space Environment is thus an applied science taking a serious view to impacts on society and practical utilities, not a basic science aimed at understanding nature. Studies that focus only on immediate application objectives are sometimes dangerous, as they often lead to the stifling of future scientific progress. Growth in the area of space utilization means a continuing expansion of the territory of human activities in space. to support this growth and to ensure the academically healthy progress in the Science of the Space Environment, it is important that future developments be grounded on sound science. This book describes the basic physical picture of the space environment from the Sun through near-Earth space, and the chain of events through which solar active phenomena produce large disturbances in the space environment. The intention is to provide as much description as possible of how changes in the space environment affect the space-borne and ground-based systems that support society.

Author
Aerospace Environments; Solar Activity; Solar Wind; Space Weather; Thermosphere; Upper Ionosphere; Weather Forecasting; Earth Ionosphere; Earth Magnetosphere; Solar Terrestrial Interactions; Solar Activity Effects; Magnetic Disturbances; Magnetic Storms

33
ELECTRONICS AND ELECTRICAL ENGINEERING

Includes development, performance, and maintainability of electrical/electronic devices and components; related test equipment. and microelectronics and integrated circuitry. For related information see also 60 Computer Operations and Hardware; and 76 Solid-State Physics. For communications equipment and devices see 32 Communications and Radar.

20010054776 Ljubljana Univ., Fakulteta za Elektrotehniko, Ljubljana, Slovenia
Synchronization of the Active Power Filter Current Reference to the Distorted Line Voltage ***Sinhronizacija tokovne reference aktivnega mocnostnega filtra na popaceno omrezno napetost***
Nedeljkovic, David, Ljubljana Univ., Slovenia; Nastran, Janez, Ljubljana Univ., Slovenia; Electrotechnical Review; 2001; ISSN 0013-5852; Volume 68, No. 1, pp. 27-31; In Slovene; Copyright; Avail: Issuing Activity

Reactive power, either the fundamental reactive power or harmonic distortion, is compensated with parallel active filters by means of which proper currents are enforced into the filter-branch. Speaking in terms of quality of supplied power, it is in particular the harmonic distortion that plays an important role. This is mostly due to the increased use of solid-state rectifiers. Several methods have been developed for determination of the filter current reference. They can be evaluated by many criteria. Triggering the filter's solid-state switches can be made according to the time-discrete principle. As the active and passive conducting intervals are not constant, the average switching frequency is lower than the basic one. This is what contributes to decreased losses and prolonged lifetime of the device. Triggering the filter's solid-state switches can be made according to the time-discrete principle. As the active and passive conducting intervals are not constant, the average switching frequency is lower than the basic one. This is what contributes to decreased losses and prolonged lifetime of the device. to provide the basis for the filter's proper operation, the filter capacitor voltage should be kept at its reference value. This is enabled by controlling the line current reference magnitude which affects the active power flow from the supply network. The idea of the proposed filter current reference determination method is based on the on-line calculation of substitutive resistance of system filter-load RFI, when only active power is supplied from the network. As the line current has the same waveform as the line voltage, synchronization to the line voltage is therefore not necessary. The reactive power is completely compensated even at a distorted line voltage. As harmonic distortion is hereby not eliminated, only the line voltage fundamental is taken into account for the proposed filter current reference determination. The line voltage fundamental is recalculated on-line with a proved synchronization principle, which is insensitive to the line voltage distortion and provides stable operation of the filter. Experimental results show that the proposed filter current reference determination method compensates both the fundamental reactive power and the harmonic distortion. The operation is stable even at an extremely distorted line voltage and the filter's response to the load variation is very fast. Key words: active power filters, reactive power, harmonic distortion, synchronization to the line voltage
Author
Distortion; Electric Potential; Switching; Synchronism; Electric Filters; Adaptive Filters

20010055263 Maribor Univ., Fakulteta za Elektrotehniko Racunalnistvo in Informatiko, Maribor, Slovenia
Experimental Method for Determination of Linear Synchronous Reluctance Motor Inductances by Using Controlled Voltage Source Inverter ***Eksperimentalna metoda dolocanja induktivnosti linearnega sinhronskega reluktancnega motorja z uporabo vodenega napetostnega pretvornika***
Stumberger, Gorazd, Maribor Univ., Slovenia; Stumberger, Bojan, Maribor Univ., Slovenia; Dolinar, Drago, Maribor Univ., Slovenia; Electrotechnical Review; 2001; ISSN 0013-5852; Volume 68, No. 1, pp. 32-39; In Slovene; Copyright; Avail: Issuing Activity

This work focuses on the determination of a two-axis Linear Synchronous Reluctance Motor (LSRM) model inductances under different operating conditions. Some authors use different experimental and numerical methods for the determination of parameters of different motor types. The experimental methods are based on the tests performed on motors supplied by the sinusoidal voltage sources and by the DC voltage sources. The basis for the numerical methods are the Finite Element Method (FEM) calculations. A two-axis dynamic model of a three-phase LSRM is presented first. The current dependent direct and quadrature axis inductances of the LSRM model are determined by experiments performed on a LSRM supplied by a controlled Voltage Source Inverter (VSI). The already existing experimental method for determination of the magnetization characteristics

of power transformers through DC excitation is modified to allow determination of current dependent inductances of the LSRM supplied by a controlled VLSI under different operating conditions. The experimentally determined inductances are compared with the inductances calculated by FEM. The agreement between obtained results is good.
Author
Dynamic Models; Electric Potential; Finite Element Method; Inverters; Synchronous Motors; Linearity

20010055265 Ljubljana Univ., Fakulteta za Elektrotehniko, Ljubljana, Slovenia
Electronic Power Supply used for Calibration of Electric Energy Meters ***Elektronski vir za umerjanje stevcev elektricne energije***
Zajec, Peter, Ljubljana Univ., Slovenia; Nastran, Janez, Ljubljana Univ., Slovenia; Electrotechnical Review; 2001; ISSN 0013-5852; Volume 68, No. 1, pp. 45-50; In Slovene; Copyright; Avail: Issuing Activity

The paper is focused on a sophisticated Switched Mode Power Supply with a pure sinusoidal output voltage waveform with adjustable frequency (40 Hz to 65 Hz) and voltage (30 V to 500 V). In order to cope with stringent voltage (0.2%) and distortion constraint (THD 0.7%) in a modern calibration system, traditional inverter design with an output LC filter is upgraded with a feedback-feedforward control principle. The paper presents the voltage source topology, analyzes its steady-state response and gives its comprehensive evaluation. Using a simple sensor that is capable to detect a small voltage asymmetry at the presence of a high AC component (500 VRMS), the parasitic DC component is limited below 5 mV. Experimental results demonstrate exceptional voltage accuracy (is less than 0.2%) and low Total Harmonic Distortion.
Author
Electric Potential; Feedback Control; Voltage Regulators; Switching Circuits; Electric Power Supplies

20010055595 Old Dominion Univ., Dept. of Electrical and Computer Engineering, Norfolk, VA USA
Electro-Thermal Simulation Studies of SiC Junction Diodes Containing Screw Dislocations Under High Reverse-Bias Operation ***Final Report***
Joshi, R. P., Old Dominion Univ., USA; May 2001; 36p; In English; Original contains color illustrations
Contract(s)/Grant(s): NAG3-2483; ODURF Proj. 104661; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The objective of this work was to conduct a modeling study of SiC P-N junction diodes operating under high reverse biased conditions. Analytical models and numerical simulation capabilities were to be developed for self-consistent electro-thermal analysis of the diode current-voltage (I-V) characteristics. Data from GRC indicate that screw dislocations are unavoidable in large area SiC devices, and lead to changes in the SiC diode electrical response characteristics under high field conditions. For example, device instability and failures linked to internal current filamentation have been observed. The physical origin of these processes is not well understood, and quantitative projections of the electrical behavior under high field and temperature conditions are lacking. Thermal calculations for SiC devices have not been reported in the literature either. So estimates or projections of peak device temperatures and power limitations do not exist. This numerical study and simulation analysis was aimed at resolving some of the above issues. The following tasks were successfully accomplished: (1) Development of physically based models using one- and two-dimensional drift-diffusion theory for the transport behavior and I-V characteristics; (2) One- and two-dimensional heat flow to account for internal device heating. This led to calculations of the internal temperature profiles, which in turn, were used to update the electrical transport parameters for a self-consistent analysis. The temperature profiles and the peak values were thus obtainable for a given device operating condition; (3) Inclusion of traps assumed to model the presence of internal screw dislocations running along the longitudinal direction; (4) Predictions of the operating characteristics with and without heating as a function of applied bias with and without traps. Both one and two-dimensional cases were implemented; (5) Assessment of device stability based on the operating characteristics. The presence of internal non-uniformities, particularly filamentary structures, was probed and demonstrated; (6) Cause and physical origins of filamentary behavior and unstable I-V characteristics were made transparent; (7) It was demonstrated that diodes containing defects would be more prone to thermal breakdown associated with the temperature dependent decrease in the thermal conductivity; and (8) Finally, negative differential resistance (S-shaped NDR) which can potential lead to device instability and filamentary behavior was shown to occur for diodes containing a line of defects such as could be associated with a screw dislocation line.
Author
Thermal Simulation; Junction Diodes; Computerized Simulation; Temperature Dependence; Mathematical Models

20010055711 Ljubljana Univ., Fakulteta za Elektrotehniko, Ljubljana, Slovenia
Experimenting with the High-Voltage Testing Board ***Visokonapetostno preskusno polje***
Kokelj, Peter, Ljubljana Univ., Slovenia; Electrotechnical Review; 2001; ISSN 0013-5852; Volume 68, No. 1, pp. 40-44; In Slovene; Copyright; Avail: Issuing Activity

Electric and magnetic fields are notions the students are first met with at their study in basics of electrical engineering. For human senses these fields are directly not sensed. It is their effect, i.e. the force on the electric charge that is perceivable. The paper deals with the high-voltage testing field designed as a testing aid in the area of the electrostatic field as needed for the laboratory students' experimenting in basics of electrical engineering. It describes tests demonstrating the electric field in the vicinity of some forms of electrodes, force on a charged body in the electric field and effects of large electric field strengths in air-gas. The attainable electrostatic force in air is some 40,000 times smaller than the attainable magnetic force in air. It is already for fields of few kV/cm in air, which are needed for reliable and repeatable tests, that high voltage is required. It is well known that working with high voltage is dangerous. This is why special safety measures must be taken to protect persons performing tests. The testing field is constructed as a high-voltage source with adequate electrodes and monitoring instruments. They are altogether mounted on an insulated base and are shielded with a Plexiglas cover. The cover provides for a sufficient protection for the person conducting the test and gives a good insight into what is going on during the test. The voltage is triggered by pressing a button while the cover is completely closed.
Author
Electric Fields; Electric Potential; Experimentation; High Voltages

20010056225 Ohio State Univ., Dept. of Materials Science and Engineering, Columbus, OH USA
Research on High Temperature Ceramic Insulation for Electrical Conductors ***Final Report***
Kreidler, Eric R., Ohio State Univ., USA; Bhallamudi, Vidya Praveen, Ohio State Univ., USA; Jun. 06, 2001; 185p; In English
Contract(s)/Grant(s): NAG3-2090
Report No.(s): RF735467; No Copyright; Avail: CASI; A09, Hardcopy; A02, Microfiche

Three methods for applying ceramic coatings to wires were examined in depth and a fourth (chemical vapor deposition) was studied briefly. CVD coatings were not reported in the thesis because it was realized early in the study that the deposition rate of the coatings was too slow to be used in a commercial process. of the methods reported in the thesis, slurry coating was the most promising. This method consists of slowly drawing a platinum wire through a thixotropic slurry of alumina in a vehicle composed of polyvinyl butyral, methyl ethyl ketone, and toluene. The coatings produced by this method were continuous and free of cracks after sintering. The sintered coatings crack when the wire is bent around sharp corners, but most of the coating remains in place and still provides electrical insulation between the wire and any metallic structure to which the wire may be attached. The coating thickness was 0.61 mm (16 micrometers). The electrical resistivity of the intact coating was 340 M-Ohm-cm at 800 C and 23 M-Ohm-cm at 1050 C. Therefore, these coatings more than meet the electrical requirements for use in turbine engines. Although adherence of the coating to the wire was generally excellent, a problem was noted in localized areas where the coating flaked off. Further work will be needed to obtain good coating adherence along the entire length of the wire. The next most promising coatings were made by electrophoretic deposition (EPD) of Al2O3 onto platinum wires, using mixtures of ethanol and acetone as the suspending liquid. These EPD coatings were made only on short lengths of wire because the coating is too fragile to allow spooling of the wire. The worst coatings were those made by electrophoretic deposition from aqueous suspensions. Continuous slurry coating of wire was achieved, but due to lack of suitable equipment, the wire had to be cut into short lengths for sintering.
Derived from text
Coatings; Slurries; Sintering; Wire; Electrical Insulation

20010057223 Massachusetts Inst. of Tech., Ceramics Processing Research Lab., Cambridge, MA USA
Forces During Manufacture and Assembly of Microscale Discrete Electronic Components
Cima, M. J., Massachusetts Inst. of Tech., USA; Microgravity Materials Science Conference 2000; March 2001; Volume 1, pp. 133-134; In English; See also 20010057199; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A01, Hardcopy

The proposed research in hybrid assembly will focus on electronic/optical component surface mount challenges for the next century. Discrete components are rapidly decreasing in dimension. Some components are becoming so small that the assembly processes used to mount them must account for static electric charge, van der Waals forces acting through surfaces, other adhesion forces, and, in the not too distant future, Brownian dynamics. Optical system assembly will present the same challenges with the added requirement of ultra precision placement. The dimensions and masses of these components place them at the boundary between ballistic entities (subject to gravity), electrostatic bodies (subject to static surface charge forces), and colloidal bodies (subject to surface and Brownian forces). The assembly processes are also subject to static charge in dielectric media such as air. The research program will demonstrate controlled electrostatic and electrophoretic forces and the use of radiation pressure for the assembly of small components. Printed areas of electrostatic charge or patterned electrode areas with applied potential will be used to attract charged components to a target. The electric field between the part and target will provide the force necessary to accurately direct the component to its correct position for final placement. The radiation pressure provided by the focused laser

beam will be used to direct the component as it moves through air or a liquid medium toward the electrode. The final orientation of the component at the target area will be determined by the shape of the target area on the substrate. This latter feature is a ”lock and key” type mechanism like that used with fluidic self-assembly processes. Both dry and wet assembly methods will be explored. These methods are referred to as electrostatic/shape assembly and electrophoretic/shape assembly, respectively. Electrostatic/shape assembly uses electric charge in much the same way as modern xerographic applications which attract charged toner particles towards charged areas on a photoconductor to create an image. The static charge that can be generated on a free surface in air limits the total charge that can be applied to a component. This limitation occurs because of dielectric breakdown of air (or the ambient gas used in the experiment). An electrical ground plane opposite the charged surface allows image charges to balance the surface charge, so that the electric field is contained almost entirely within the dielectric. Thus the surface charge density that may be applied to a target area on a thin, electrically grounded dielectric substrate, is limited by the dielectric strength of the substrate, allowing a much higher surface charge to be deposited.
Author
Optical Equipment; Dielectric Properties; Electric Fields; Electrostatic Charge; Photoconductors

20010057608 Fermi National Accelerator Lab., Batavia, IL USA
Radiation Tolerant Circuits Designed in 2 Commercial 0.25 Micron CMOS Processes
Mekkaoui, A.; Hoff, J.; Christian, D. C.; Wester, W.; Yarema, R.; Mar. 2001; 8p; In English
Contract(s)/Grant(s): DE-AC02-76CH-03000
Report No.(s): PB2001-105434; FERMILAB-CONF-01/026-E; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche
Characterization of simple devices as well as complex circuits, in two commercial 0.25 micron processes, demonstrates a high level (up to 58 Mrad) radiation tolerance of these technologies. They are also very likely to be immune to single event gate damage according to our results form 200MeV-protons irradiation.
NTIS
CMOS; Radiation Tolerance; Chips (Electronics); Radiation Hardening; Integrated Circuits; Irradiation

20010057610 Fermi National Accelerator Lab., Batavia, IL USA
Development of a High Density Pixel Multichip Module at Fermilab
Cardoso, G.; Zimmermann, S.; Kwan, S. W.; Andresen, J.; Appel, J. A.; Mar. 2001; 10p; In English
Contract(s)/Grant(s): DE-AC02-76CH-03000
Report No.(s): PB2001-105431; FERMILAB-CONF-01/016-E; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche
At Fermilab, both pixel detector multichip module and sensor hybridization are being developed for the BTeV experiment.The BTeV pixel detector is based on a design relying on a hybrid approach. With this approach, the readout chip and the sensor array are developed separately and the detector is constructed by flip-chip mating the two together.This paper presents strategies to handle the required data rate and perormance results of the first prototype and detector hybridization.
NTIS
Chips (Electronics); Prototypes

20010058890 NASA Glenn Research Center, Cleveland, OH USA
Coupling Between Microstrip Lines Embedded in Polyimide Layers for 3D-MMICs on Si
Ponchak, George E., NASA Glenn Research Center, USA; Tentzeris, Emmanouil M., Georgia Inst. of Tech., USA; Papapolymerou, John, Arizona Univ., USA; [2001]; 4p; In English; IEEE MTT-S International Microwave Symposium, 20-25 May 2001, Phoenix, AZ, USA; Sponsored by Institute of Electrical and Electronics Engineers, USA
Contract(s)/Grant(s): RTOP 755-08-0B; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche
Three-dimensional circuits built upon multiple layers of polyimide are required for constructing Si/SiGe monolithic microwave/millimeter-wave integrated circuits on CMOS (low resistivity) Si wafers. However, the closely spaced transmission lines are susceptible to high levels of coupling, which degrades circuit performance. In this paper, Finite Difference Time Domain (FDTD) analysis and measured characteristics of novel shielding structures that significantly reduce coupling between embedded microstrip lines are presented.
Author
Microstrip Transmission Lines; Microwave Circuits; Millimeter Waves; Integrated Circuits

20010059032 Analex Corp., Cleveland, OH USA

Fully Three-Dimensional Helical RF Field Effects on TWT Interaction

Kory, Carol L., Analex Corp., USA; [2000]; 2p; In English

Contract(s)/Grant(s): NAS3-27600; RTOP 632-6E-51; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

The phenomenal growth of the satellite communications industry has created a large demand for traveling wave-tubes (TWTs) operating with unprecedented specifications requiring design and production of many novel devices in record time. to achieve this, the TWT industry heavily relies upon computational modeling. However, there is a need for improvement in the TWT industry's computational modeling capabilities as there are often discrepancies between measured TWT data and that predicted by conventional two-dimensional helical TWT interaction codes. This severely limits the analysis and design of novel devices or TWTs with parameters differing from what is conventionally manufactured. In addition, the inaccuracy of current computational tools limits achievable TWT performance because optimized designs require highly accurate models. In particular, collector efficiency, which significantly affects overall TWT efficiency, is difficult to optimize unless extremely accurate spent beam data is predicted by the interaction code.

Derived from text

Traveling Wave Tubes; Satellite Communication; Software Development Tools; Computer Techniques

20010059038 Analex Corp., Cleveland, OH USA

Investigation of Fully Three-Dimensional Helical RF Field Effects on TWT Beam/Circuit Interaction

Kory, Carol L., Analex Corp., USA; [2000]; 26p; In English

Contract(s)/Grant(s): NAS3-27600; RTOP 632-6E-51; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A fully three-dimensional (3D), time-dependent, helical traveling wave-tube (TWT) interaction model has been developed using the electromagnetic particle-in-cell (PIC) code MAFIA. The model includes a short section of helical slow-wave circuit with excitation fed by RF input/output couplers, and electron beam contained by periodic permanent magnet (PPM) focusing. All components of the model are simulated in three dimensions allowing the effects of the fully 3D helical fields on RF circuit/beam interaction to be investigated for the first time. The development of the interaction model is presented, and predicted TWT performance using 2.5D and 3D models is compared to investigate the effect of conventional approximations used in TWT analyses.

Author

Radio Frequencies; Three Dimensional Models; Electromagnetic Fields; Traveling Wave Tubes; Electron Beams; Beam Interactions; Wave Propagation

20010059379 NASA Glenn Research Center, Cleveland, OH USA

Comparison of the Experimental Performance of Ferroelectric CPW Circuits with Method of Moment Simulations and Conformal Mapping

VanKeuls, Fred W., NASA Glenn Research Center, USA; Chevalier, Chris T., NASA Glenn Research Center, USA; Miranda, Felix A., NASA Glenn Research Center, USA; Carlson, C. M., Micron Technology, Inc., USA; Rivkin, T. V., Midwest Research Inst., USA; Parilla, P. A., Midwest Research Inst., USA; Perkins, J. D., Midwest Research Inst., USA; Ginley, D. S., Midwest Research Inst., USA; [2001]; 6p; In English

Contract(s)/Grant(s): RTOP 632-6E-51; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Experimental measurements of coplanar waveguide (CPW) circuits atop thin films of ferroelectric Ba(x)SR(1-x)TiO3 (BST) were made as a function bias from 0 to 200 V and frequency from 0.045 to 20 GHz. The resulting phase shifts are compared with method of moments electromagnetic simulations and a conformal mapping analysis to determine the dielectric constant of the BST films. Based on the correlation between the experimental and the modeled data, an analysis of the extent to which the electromagnetic simulators provide reliable values for the dielectric constant of the ferroelectric in these structures has been performed. In addition, to determine how well the modeled data compare with experimental data, the dielectric constant values were also compared to low frequency measurements of interdigitated capacitor circuits on the same films. Results of these comparisons will be presented.

Author

Circuits; Ferroelectricity; Thin Films; Waveguides; Conformal Mapping; Simulation; Ferroelectric Materials; Phase Shift

20010059606 NASA Glenn Research Center, Cleveland, OH USA

Finite Ground Coplanar Waveguide Shunt MEMS Switches for Switched Line Phase Shifters

Ponchak, George E., NASA Glenn Research Center, USA; Simons, Rainee N., NASA Glenn Research Center, USA; Scardelletti, Maximillian, NASA Glenn Research Center, USA; Varaljay, Nicholas C., NASA Glenn Research Center, USA; [2000]; 4p; In

English; 2000 IEEE European Microwave Conference, 3 Oct. 2000, Paris, France; Sponsored by Institute of Electrical and Electronics Engineers, USA
Contract(s)/Grant(s): RTOP 632-6E-51; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

Switches with low insertion loss and high isolation are required for switched line phase shifters and the transmit/receive switch at the front end of communication systems. A Finite Ground Coplanar (FGC) waveguide capacitive, shunt MEMS switch has been implemented on high resistivity Si. The switch has demonstrated an insertion loss of less than 0.3 dB and a return loss greater than 15 dB from 10 to 20, GHz. The switch design, fabrication, and characteristics are presented.
Author
Switches; Insertion Loss; Microelectromechanical Systems; Isolation; Electrical Resistivity; Waveguides

20010059857 Wisconsin Univ., Electrical and Computer Engineering Dept., Madison, WI USA
Micromachined TWTs for THz Radiation Sources
Booske, John H., Wisconsin Univ., USA; vanderWeide, Daniel W., Wisconsin Univ., USA; Kory, Carol L., Analex Corp., USA; Limbach, S., Wisconsin Univ., USA; [2001]; 2p; In English; International Vacuum Electronics Conference, 2-4 Apr. 2001, Noordwijk, Netherlands; Sponsored by Institute of Electrical and Electronics Engineers, USA
Contract(s)/Grant(s): NAS3-27600; RTOP 632-6E-51; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

The Terahertz (THz) region of the electromagnetic spectrum (about 300 - 3000 GHz in frequency or about 0.1 - 1 mm free space wavelength) has enormous potential for high-data-rate communications, spectroscopy, astronomy, space research, medicine, biology, surveillance, remote sensing, industrial process control, etc. It has been characterized as the most scientifically rich, yet under-utilized, region of the electromagnetic spectrum. The most critical roadblock to full exploitation of the THz band is lack of coherent radiation sources that are powerful (0.001 - 1.0 W continuous wave), efficient (> 1%), frequency agile (instantaneously tunable over 1% bandwidths or more), reliable, and comparatively inexpensive. to develop vacuum electron device (VED) radiation sources satisfying these requirements, fabrication and packaging approaches must be heavily considered to minimize costs, in addition to the basic interaction physics and circuit design. to minimize size of the prime power supply, beam voltage must be minimized, preferably 10 kV. Solid state sources satisfy the low voltage requirement, but are many orders of magnitude below power, efficiency, and bandwidth requirements. On the other hand, typical fast-wave VED sources in this regime (e.g., gyrotrons, FELs) tend to be large, expensive, high voltage and very high power devices unsuitable for most of the applications cited above. VEDs based on grating or inter-digital (ID) circuits have been researched and developed. However, achieving forward-wave amplifier operation with instantaneous fractional bandwidths is greater than 1% is problematic for these devices with low-energy (is less than 15 kV) electron beams. Moreover, the interaction impedance is quite low unless the beam-circuit spacing is kept particularly narrow, often leading to significant beam interception. One solution to satisfy the THz source requirements mentioned above is to develop micromachined VEDs, or ”micro-VEDs”. Among other benefits, micro-machining technologies provide superior high frequency wall conductivity as a result of superior surface smoothness compared with conventional mechanical or electric discharge machining approaches. Micro-VED technologies are already being applied to the development of millimeter-wave klystrons at Stanford Linear Accelerator Center and submillimeter-wave klystrons at the University of Leeds. We are investigating the use of micro-machining technologies to develop THz regime TWTs, with emphasis on folded-waveguide TWTs. The folded-waveguide TWT (FW-TWT) has several features that make it attractive for THz-regime micro-VED applications. It is a relatively simple circuit to design and fabricate, it is amenable to precision pattern replication by micro-machining, and it is has been demonstrated capable of forward-wave amplification with appreciable bandwidth. We are conducting experimental and computational studies of micro-VED FW-TWTs to examine their feasibility for applications at frequencies from 200 - 1000 GHz.
Author
Circuits; Micromachining; Radiation Sources; Traveling Wave Tubes; Waveguides; Extremely High Frequencies; Millimeter Waves; Far Infrared Radiation

20010059872 NASA Glenn Research Center, Cleveland, OH USA
Experimental Verification of the Use of Metal Filled Via Hole Fences for Crosstalk Control of Microstrip Lines in LTCC Packages
Ponchak, George E., NASA Glenn Research Center, USA; Chun, Donghoon, Michigan Univ., USA; Yook, Jong-Gwan, Kwang-Ju Inst. of Science and Technology, Korea, Republic of; Katehi, Linda P. B., Michigan Univ., USA; IEEE Transactions on Advanced Packaging; [2001]; ISSN 1521-3323; Volume 24, No. 1; 5p; In English
Contract(s)/Grant(s): NSF CDA-92-14296; RTOP 755-08-0B; Copyright; Avail: Issuing Activity

Coupling between microstrip lines in dense RF packages is a common problem that degrades circuit performance. Prior three-dimensional-finite element method (3-D-FEM) electromagnetic simulations have shown that metal filled via hole fences

between two adjacent microstrip lines actually Increases coupling between the lines: however, if the top of the via posts are connected by a metal strip, coupling is reduced. In this paper, experimental verification of the 3-D-FEM simulations is demonstrated for commercially fabricated low temperature cofired ceramic (LTCC) packages. In addition, measured attenuation of microstrip lines surrounded by the shielding structures is presented and shows that shielding structures do not change the attenuation characteristics of the line.
Author
Microstrip Transmission Lines; Coupling; Metal Strips; Radio Frequencies; Crosstalk; Circuits

20010059943 Stanford Univ., Stanford, CA USA
Phase Coherent Transport and Use of Feedback in Ballistic GaAs/AlGaAs Microstructures ***Final Report, 1 Jul. 1995 - 31 Dec. 1998***
Marcus, Charles M.; Jan. 01, 2001; 4p; In English
Contract(s)/Grant(s): DAAH04-95-1-0331
Report No.(s): AD-A388919; ARO-32783.23-PH-YIP; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche
The aim of the funded research has been to investigate the use of feedback in phase-coherent electronic systems. Quantum dots afford the most controllable quantum system presently being investigated, because DC voltages applied to gates control the confining potentials that form the system. Over the course of the funding cycle, discoveries were made concerning the sensitivity of quantum dots to external perturbation, universal theoretical laws for quantum chaotic systems, and the crossover from open to closed quantum systems, the relation between ground and excited states, and the sensitivity of phase coherence to external radiation. Overall, 10 Physical Review Letters, 2 Science Papers, and 1 Applied Physics Letter were among the papers published that were supported by this grant.
DTIC
Feedback; Quantum Dots; Gallium Arsenides; Aluminum Gallium Arsenides; Phase Coherence; Electric Potential

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FLUID MECHANICS AND THERMODYNAMICS

Includes fluid dynamics and kinematics and all forms of heat transfer; boundary layer flow; hydrodynamics; hydraulics; fluidics; mass transfer and ablation cooling. For related information see also 02 Aerodynamics.

20010054984 Army Research Lab., Human Research and Engineering Directorate, Aberdeen Proving Ground, MD USA
Viscous CFD Calculations of Grid Fin Missile Aerodynamics in the Supersonic Flow Regime
DeSpirito, James; Sahu, Jubaraj; Apr. 2001; 24p; In English; Original contains color plates
Contract(s)/Grant(s): 1L162618AH80
Report No.(s): AD-A388765; ARL-RP-19; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
This report presents the results of an investigation to use viscous computational fluid dynamic calculations to predict the flowfleld and aerodynamic coefficients for a missile with grid fins in the supersonic flow regime. The calculations were made at Mach 2 and 3 and several angles of attack. The results were validated by comparing the computed aerodynamic coefficients against wind tunnel experimental data. Good agreement was found between the computed and experimental axial force coefficients, with the difference between 4 and 8%. Reasonable agreement was found for the normal force coefficient, with a difference of 8-16%. The agreement between the computed and experimental pitching moment coefficient was not as good, with a difference of 16-27%. Good agreement was found for the location of the center of pressure, with a difference of 6-10%. The flowfield around the individual grid fins and the normal force on the fins showed characteristics similar to those found in an earlier study.
DTIC
Computational Fluid Dynamics; Fins; Missiles; Supersonic Flow; Wind Tunnel Tests; Aerodynamic Characteristics

20010055246 NASA Langley Research Center, Hampton, VA USA
Application of a Scalable, Parallel, Unstructured-Grid-Based Navier-Stokes Solver
Parikh, Paresh, NASA Langley Research Center, USA; [2001]; 10p; In English; 15th AIAA Computational Fluid Dynamics Conference, 11-14 Jun. 2001, Anaheim, CA, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA; Original contains color illustrations
Report No.(s): AIAA Paper 2001-2584; Copyright Waived; Avail: CASI; A02, Hardcopy; A01, Microfiche

A parallel version of an unstructured-grid based Navier-Stokes solver, USM3Dns, previously developed for efficient operation on a variety of parallel computers, has been enhanced to incorporate upgrades made to the serial version. The resultant parallel code has been extensively tested on a variety of problems of aerospace interest and on two sets of parallel computers to understand and document its characteristics. An innovative grid renumbering construct and use of non-blocking communication are shown to produce superlinear computing performance. Preliminary results from parallelization of a recently introduced ”porous surface” boundary condition are also presented.
Author
Unstructured Grids (Mathematics); Navier-Stokes Equation; Parallel Processing (Computers); Computational Fluid Dynamics

20010055247 NASA Langley Research Center, Hampton, VA USA
Factorizable Upwind Schemes: the Triangular Unstructured Grid Formulation
Nielsen, Eric J., NASA Langley Research Center, USA; Sidilkover, David, Institute for Computer Applications in Science and Engineering, USA; [2001]; 10p; In English; 15th AIAA Computational Fluid Dynamics Conference, 11-14 Jun. 2001, Anaheim, CA, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Report No.(s): AIAA Paper 2001-2575; Copyright Waived; Avail: CASI; A02, Hardcopy; A01, Microfiche
The upwind factorizable schemes for the equations of fluid was introduced recently. They facilitate achieving the Textbook Multigrid Efficiency (TME) and are expected also to result in the solvers of unparalleled robustness. The approach itself is very general. Therefore, it may well become a general framework for the large-scale Computational Fluid Dynamics. In this paper we outline the triangular grid formulation of the factorizable schemes. The derivation is based on the fact that the factorizable schemes can be expressed entirely using vector notation, without explicitly mentioning a particular coordinate frame. We describe the resulting discrete scheme in detail and present some computational results verifying the basic properties of the scheme/solver.
Author
Upwind Schemes (Mathematics); Unstructured Grids (Mathematics); Factorization

20010055656 National Taiwan Univ., Dept. of Civil Engineering and Hydrotech Research Inst., Taipei, Taiwan, Province of China
Solution of Stokes Flow Problem Using Dual Reciprocity Boundary Element Method
Eldho, T. I., National Taiwan Univ., Taiwan, Province of China; Young, Der-Liang, National Taiwan Univ., Taiwan, Province of China; Journal of the Chinese Institute of Engineers; March 2001; ISSN 0253-3839; Volume 24, No. 2, pp. 141-150; In English; Copyright; Avail: Issuing Activity
This paper describes a dual reciprocity boundary element model for the solution of incompressible viscous flows in slow motion, using velocity-vorticity variables. The method involves the solution of advection-diffusion type vorticity equations for vorticity whose solenoidal vorticity components arc obtained by solving Poisson type equations involving the velocity and vorticity components. Both the Poisson type equations and the vorticity advection-diffusion type equations are solved using the dual reciprocity boundary element method (DRBEM). In DRBEM, all source terms, advective terms and time dependent terms are converted into boundary integrals and hence the computational domain of the problem reduces by one. Here the results of Stokes flow problems with very low Reynolds numbers in a typical square cavity are presented and compared with other model results. The DRBEM model has been found to be feasible and satisfactory.
Author
Stokes Flow; Boundary Element Method; Boundary Conditions

20010056272 NASA Marshall Space Flight Center, Huntsville, AL USA
Global Optimization Techniques for Fluid Flow and Propulsion Devices
Shyy, Wei, Florida Univ., USA; Papila, Nilay, Florida Univ., USA; Vaidyanathan, Raj, Florida Univ., USA; Tucker, Kevin, NASA Marshall Space Flight Center, USA; Griffin, Lisa, NASA Marshall Space Flight Center, USA; Dorney, Dan, NASA Marshall Space Flight Center, USA; Huber, Frank; Tran, Ken; [2001]; 32p; In English; Marshall Space Flight Center Fluids Workshop, 4-5 Apr. 2001, Huntsville, AL, USA
Contract(s)/Grant(s): NAG8-1251; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
This viewgraph presentation gives an overview of global optimization techniques for fluid flow and propulsion devices. Details are given on the need, characteristics, and techniques for global optimization. The techniques include response surface methodology (RSM), neural networks and back-propagation neural networks, design of experiments, face centered composite design (FCCD), orthogonal arrays, outlier analysis, and design optimization.
CASI
Design Optimization; Experiment Design; Neural Nets

20010056325 FROM

Ehrenfest's Argument Extended to a Formalism of Nonequilibrium Thermodynamics

Gorban, A. N.; Karlin, I. V.; Oettinger, H. C.; Tatarinova, L. L.; Nov. 2000; 16p; In English

Report No.(s): PB2001-105050; IHES/P/00/78; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A general method of constructing dissipative equations is developed, following Ehrenfest's idea of coarse-graining. The approach resolves the major use of discrete time coarse-graining versus continuous time macro-construction are presented, and generalizations are suggested.

NTIS

Nonequilibrium Thermodynamics; Approximation; Polymers; Numerical Analysis

20010056682 DynaFlow, Inc., Fulton, MD USA

Determination of the Accommodation Coefficient Using Vapor/Gas Bubble Dynamics in an Acoustic Field ***Final Report***

Gumerov, Nail A., DynaFlow, Inc., USA; Hsiao, Chao-Tsung, DynaFlow, Inc., USA; Goumilevski, Alexei G., DynaFlow, Inc., USA; January 2001; 122p; In English

Contract(s)/Grant(s): NAS3-98094; RTOP 101-13-0A

Report No.(s): NASA/CR-2001-210572; NAS 1.26:210572; E-12538; TR-98001; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

Nonequilibrium liquid/vapor phase transformations can occur in superheated or subcooled liquids in fast processes such as in evaporation in a vacuum. The rate at which such a phase transformation occurs depends on the "condensation" or "accommodation" coefficient, Beta, which is a property of the interface. Existing measurement techniques for Beta are complex and expensive. The development of a relatively inexpensive and reliable technique for measurement of Beta for a wide range of substances and temperatures is of great practical importance. The dynamics of a bubble in an acoustic field strongly depends on the value of Beta. It is known that near the saturation temperature, small vapor bubbles grow under the action of an acoustic field due to "rectified heat transfer." This finding can be used as the basis for an effective measurement technique of Beta. We developed a theory of vapor bubble behavior in an isotropic acoustic wave and in a plane standing acoustic wave. A numerical code was developed which enables simulation of a variety of experimental situations and accurately takes into account slowly evolving temperature. A parametric study showed that the measurement of Beta can be made over a broad range of frequencies and bubble sizes. We found several interesting regimes and conditions which can be efficiently used for measurements of Beta. Measurements of Beta can be performed in both reduced and normal gravity environments.

Author

Gas Dynamics; Liquid-Vapor Interfaces; Bubbles; Accommodation Coefficient; Microgravity; Vapors

20010056687 Syracuse Univ., NY USA

Workshop on Boundary Layer Transition and Unsteady Aspects of Turbomachinery ***Final Report***

LaGraff, John E., Syracuse Univ., USA; Apr. 03, 2001; 10p; In English, 20-23 Aug. 2000, Blue Mountain Lake, NY, USA

Contract(s)/Grant(s): NAG3-2309

Report No.(s): Rept-359-4163; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

A workshop was organized on the topic of the title and held on August 20-23, 2000 at the Syracuse University Minnowbrook Conference Center in Blue Mountain Lake, New York. Attendance was by invitation only, forty-two guests attended and thirty presentations were made. Support was received from NASA Glenn Research Center, the US Air Force Office of Scientific Research the European Office of Aeronautical Research and Development, the Asian Office of Aeronautical Research and Development and Syracuse University. This workshop was the third in a trienniel series beginning in 1993. A publication under a NASA CP number will be issued and include all abstracts. No full written papers were required. This report includes a list of attendees and the program of presentations. The next workshop is scheduled for August 2003.

Author

Turbomachinery; Boundary Layer Transition; Unsteady Flow

20010057234 North Carolina State Univ., Dept. Materials Science & Engineering, Raleigh, NC USA

Real-Time Optical Monitoring of Flow Kinetics and Gas Phase Reactions Under High-Pressure OMCVD Conditions

Dietz, N., North Carolina State Univ., USA; McCall, S., North Carolina State Univ., USA; Bachmann, K. J., North Carolina State Univ., USA; Microgravity Materials Science Conference 2000; March 2001; Volume 1, pp. 176-181; In English; See also 20010057199; CD-ROM contains the entire Conference Proceedings presented in PDF format

Contract(s)/Grant(s): NCC8-95; NAG8-1686; F49620-95-1-0447; No Copyright; Avail: CASI; A02, Hardcopy

This contribution addresses the real-time optical characterization of gas flow and gas phase reactions as they play a crucial role for chemical vapor phase depositions utilizing elevated and high pressure chemical vapor deposition (HPCVD) conditions. The objectives of these experiments are to validate on the basis of results on real-time optical diagnostics process models simulation codes, and provide input parameter sets needed for analysis and control of chemical vapor deposition at elevated pressures. Access to microgravity is required to retain high pressure conditions of laminar flow, which is essential for successful acquisition and interpretation of the optical data. In this contribution, we describe the design and construction of the HPCVD system, which include access ports for various optical methods of real-time process monitoring and to analyze the initial stages of heteroepitaxy and steady-state growth in the different pressure ranges. to analyze the onset of turbulence, provisions are made for implementation of experimental methods for in-situ characterization of the nature of flow. This knowledge will be the basis for the design definition of experiments under microgravity, where gas flow conditions, gas phase and surface chemistry, might be analyzed by remote controlled real-time diagnostics tools, developed in this research project.
Author
Metalorganic Chemical Vapor Deposition; Reaction Kinetics; Surface Reactions; Nitrides; Epitaxy; Computerized Simulation

20010057293 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; Bellizia, G., Illinois Univ., USA; Wallace, D. B., Microfab Technologies, Inc., USA; Microgravity Materials Science Conference 2000; March 2001; Volume 2, pp. 440-445; In English; See also 20010057256; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A02, Hardcopy

Surface tension forces play a critical role in fluid dynamical phenomena, which are important in materials processing. These forces can be 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. This research program investigates the adsorption kinetics of oxygen on the surface of tin-containing metal melts. Oxygen adsorption poses a severe impediment in processing technologies involving jetting of pure tin or tin-based alloys. While the problem of interest is one of fundamental fluid transport and surface science, it is also directly related to the novel technology of dispension (printing) of microscopic solder deposits for the surface mounting of microelectronic devices. This technology, known as solder jetting, features deposition of solder droplets in very fine, very accurate patterns using techniques analogous to those developed for the ink-jet printing industry. A major development challenge in the commercialization of solder jetting technology stems from the need to maintain adequate control of the local inert environment around the atomizing jet and the formed droplets for a wide variety of industrial applications. to this end, the limitations of solder jetting must be quantified as a function of oxygen content in the local inert environment. Alternatively, this requires the quantification of the influence of oxygen gaseous impurities in the ambient on the dynamic surface tension properties of the employed solder melts.
Author
Interfacial Tension; Liquid Metals; Microgravity; Adsorption; Oxygen; Reaction Kinetics; Tin Alloys; Atomizing; Gravitational Effects; Jet Control

20010057296 Alabama Univ., Von Braun Research Inst., Huntsville, AL USA
Reduction of Convection in Closed Tube Vapor Growth Experiments
Naumann, Robert J., Alabama Univ., USA; Shin, In-Seok, Alabama Univ., USA; Microgravity Materials Science Conference 2000; March 2001; Volume 2, pp. 449-450; In English; See also 20010057256; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A01, Hardcopy

The objective of this proposed effort is to test a novel method for suppressing convective flows during the growth of crystals by vapor transport in closed tubes to levels approaching those obtained in the microgravity environment. 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. If successful, this growth technique will offer a screening test for proposed space experiments that involve vapor

transport to see if reduction of convection will result in improved material and will set a new standard against which the improvements obtained in microgravity may be judged. In addition, it may provide an improved method for preparing materials on Earth whose growth is affected adversely by convection.
Author
Convective Flow; Crystal Growth; Microgravity; Spaceborne Experiments; Vapor Deposition; Crystals; Fabrication

20010057309 Massachusetts Univ., Dept. of Polymer Science, Amherst, MA USA
Capillary Waves at Interfaces: The Role of Gravity and Electric Fields
Kerle, Tobias, Massachusetts Univ., USA; Lin, Z., Massachusetts Univ., USA; Baker, S., Massachusetts Univ., USA; Mays, Jimmy W., Alabama Univ., USA; Russell, Thomas P., Massachusetts Univ., USA; Microgravity Materials Science Conference 2000; March 2001; Volume 3, pp. 516; In English; See also 20010057302; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: Issuing Activity; Abstract Only

Any interface between a fluid and a gas or two fluids contains capillary waves whose amplitudes are governed by interfacial tension and geometric constraints and whose wavelengths are dictated by the interfacial tension and external fields, e.g. electric or gravitational fields. Earlier studies of our group on capillary waves at liquid-air interfaces have shown, that electric fields applied normal to the interface may be used to effectively select and amplify fluctuations of the interface with a characteristic wavelength lambda(m). Ultimately a hexagonal array of vertically standing columns is created. Here we extend this study to the more general case of a liquid-liquid interface subjected to an external field. The objective of this study is to develop a basic understanding of the manner in which capillary waves at interfaces can be manipulated by external fields. This is an essential key for controlling structure formation at these interfaces. Two component polymer systems in an external field may then be used to develop novel morphologies that can be quenched or frozen-in for potential further applications. We present here a theoretical framework for the early stages of structure formation at liquid-liquid interfaces along with supporting experimental evidence. Both, calculations and experiments, indicate that the lateral structure size can be effectively tuned over many orders of magnitude simply by modifying the interfacial tension.
Author
Capillary Waves; Electric Fields; Liquid-Liquid Interfaces; Gravitational Effects; Interfacial Tension; Microgravity; Capillary Flow

20010057314 Carnegie-Mellon Univ., Dept. of Physics and Mathematics, Pittsburgh, PA USA
Lattice Boltzmann Computations of Binary Diffusion in Liquids Under Stochastic Microgravity
Sekerka, Robert F., Carnegie-Mellon Univ., USA; Microgravity Materials Science Conference 2000; March 2001; Volume 3, pp. 533-538; In English; See also 20010057302; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A02, Hardcopy

The broad objective of this research is to further develop the Lattice Boltzmann (LB) model in binary liquids as a computational tool in order to better understand convective diffusion in stochastic microgravity. We focus on binary liquid alloy diffusion couples and seek to estimate the accuracy of, or make corrections to, binary liquid diffusivities measured in microgravity. We hypothesize that the Lattice Boltzmann model might be superior to computational fluid dynamics for computation of diffusion and fluid flow in binary liquids under the influence of stochastic microgravity because the LB model is intrinsically statistical and therefore more compatible with stochastic forces. The ultimate objective is to provide powerful computational methods to analyze the effects of stochastic microgravity on various space experiments that involve convective diffusion in liquids. The methodology requires reformulation of the LB model for binary fluids to account for non-solenoidal flows for species of different mass and for incompressible fluids whose density is a function of composition. Finite Difference Lattice Boltzmann models are used in order to allow the space lattice to be decoupled from the velocity discretization. Such models will first be used to explore the effect of periodic g-jitter on measured diffusivities in microgravity. Then the effect of stochastic g-jitter will be studied.
Author
Spaceborne Experiments; Microgravity; Mathematical Models; Liquids; Binary Fluids; Diffusion; Binary Alloys; Boltzmann Distribution; Two Fluid Models; Convection

20010057780 NASA Langley Research Center, Hampton, VA USA
Characterization of Measurement Error Sources in Doppler Global Velocimetry
Meyers, James F., NASA Langley Research Center, USA; Lee, Joseph W., NASA Langley Research Center, USA; Schwartz, Richard J., FDC/NYMA, Inc., USA; Measurement Science and Technology; 2001; ISSN 0957-0233; Volume 12, pp. 357-368; In English; Copyright; Avail: Issuing Activity

Doppler global velocimetry uses the absorption characteristics of iodine vapor to provide instantaneous three-component measurements of flow velocity within a plane defined by a laser light sheet. Although the technology is straightforward, its utilization as a flow diagnostics tool requires hardening of the optical system and careful attention to detail during data acquisition and processing if routine use in wind tunnel applications is to be achieved. A development program that reaches these goals is presented. Theoretical and experimental investigations were conducted on each technology element to determine methods that increase measurement accuracy and repeatability. Enhancements resulting from these investigations included methods to ensure iodine vapor calibration stability, single frequency operation of the laser and image alignment to sub-pixel accuracies. Methods were also developed to improve system calibration, and eliminate spatial variations of optical frequency in the laser output, spatial variations in optical transmissivity and perspective and optical distortions in the data images. Each of these enhancements is described and experimental examples given to illustrate the improved measurement performance obtained by the enhancement. The culmination of this investigation was the measured velocity profile of a rotating wheel resulting in a 1.75% error in the mean with a standard deviation of 0.5 m/s. Comparing measurements of a jet flow with corresponding Pitot measurements validated the use of these methods for flow field applications.
Author
Flow Velocity; Iodine; Vapors; Velocity Distribution; Wind Tunnel Tests; Velocity Measurement

20010058877 Los Alamos National Lab., NM USA
Ab initio Derivation of Stress and Strain in Fluid Foams
Jang, Y.; Asispauskas, M.; Glazier, J. A.; Aubouy, M.; Granier, F.; 2001; 16p; In English; 'Eurofoam 2000' Conference, 4-8 Jun. 2000, Delft, Netherlands
Report No.(s): PB2001-105667; LA-UR-00-2908; No Copyright; Avail: National Technical Information Service (NTIS)
The authors define in 2D random foam the mesoscopic stress and strain, which can be directly measured from a foam picture. They evaluate the mesoscopic definition in static foams. Comparing the shearing flow of monodispersed and polydispersed foams, we discuss the stress-strain relationship in the elastic regime and the transition between the elastic and the viscous regimes.
NTIS
Foams; Stress-Strain Relationships; Fluid Mechanics

20010059187 Los Alamos National Lab., NM USA
3D, Automated, Self-Contained Grid Generation Within the RAGE CAMR Hydrocode
Oakes, W. R.; Henning, P. J.; Gittings, M. L.; Weaver, R. P.; 2001; 16p; In English; 7th; International Conference on Numerical Grid Generation in Computational Field Simulations
Report No.(s): PB2001-105677; LA-UR-00-2996; No Copyright; Avail: National Technical Information Service (NTIS)
The authors discuss using the inherent grid manipulation capability within a Continuously Adaptive Mesh Refinement hydrodynamics code, RAGE, to implement parallel, automated, self-contained grid generation. In the report, We show how arbitrarily complex 3D geometries specified in any unambiguous form can be used.
NTIS
Computational Grids; Grid Generation (Mathematics); Hydrodynamics; Computer Aided Design

20010059604 NASA Glenn Research Center, Cleveland, OH USA
Evolution of Rotor Wake in Swirling Flow
El-Haldidi, Basman, Notre Dame Univ., USA; Atassi, Hafiz, Notre Dame Univ., USA; Envia, Edmane, NASA Glenn Research Center, USA; Podboy, Gary, NASA Glenn Research Center, USA; [2000]; 11p; In English; 6th AIAA/CEAS Aeroacoustics Conference, 23-26 Jun. 2000, Maui, HI, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Contract(s)/Grant(s): RTOP 522-81-11
Report No.(s): AIAA Paper 2000-1991; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
A theory is presented for modeling the evolution of rotor wakes as a function of axial distance in swirling mean flows. The theory, which extends an earlier work to include arbitrary radial distributions of mean swirl, indicates that swirl can significantly alter the wake structure of the rotor especially at large downstream distances (i.e., for moderate to large rotor-stator spacings). Using measured wakes of a representative scale model fan stage to define the mean swirl and initial wake perturbations, the theory is used to predict the subsequent evolution of the wakes. The results indicate the sensitivity of the wake evolution to the initial profile and the need to have complete and consistent initial definition of both velocity and pressure perturbations.
Author
Perturbation; Radial Distribution; Swirling; Wakes

35
INSTRUMENTATION AND PHOTOGRAPHY

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 Avionics and Aircraft Instrumentation; and 19 Spacecraft Instrumentation.

20010054777 Maribor Univ., Fakulteta za Elektrotehniko, Racunalnistvo in informatiko, Maribor, Slovenia
Development of Microcomputer Level Sensor with the Use of LabView Software ***Razvoj mikroprocesorskega senzorja nivoja z uporabo programske opreme LabView***
Polutnik, Aleksander, Maribor Univ., Slovenia; Tovornik, Boris, Maribor Univ., Slovenia; Urbanija, Miha, ULTRA; Electrotechnical Review; 2001; ISSN 0013-5852; Volume 68, No. 1, pp. 51-56; In Slovene; Copyright; Avail: Issuing Activity

At the Laboratory of Process Automation of the Faculty of Electrical Engineering and Computer Science of Maribor and in co-operation with Ultra Enterprise the microcomputer part of the capacitive level sensor vas developed. The standard procedure was modified so as to ensure shortening of the overall development time. Graphics software tools used as a metric standard were employed, providing basic validation and development of algorithms in LabView graphical software. Finally, tested solutions made in C and implemented in a microcomputer. The procedure was used for the development of measurement algorithms and for communication protocol. In its first part the paper describes the development of the analogue part of the sensor. It begins with physical principle for calculation algorithms of the measurement signal and continues with principle of level measurement with segmental capacitate sensor in its use for the fuel measurement in tanks. The communication protocol and mechanical realization of the sensor are shortly described. Advantages and limitations of the graphic programming are also outlined. The most important advantages are development time shortening and better procedure visualisation. Future work will be focused on automation of algorithm transferability from the graphic to C programming language.
Author
Capacitance; Computer Techniques; Software Engineering; Probes

20010054944 NASA Johnson Space Center, Houston, TX USA
Microencapsulation and Electrostatic Processing Device
Morrison, Dennis R., Inventor, NASA Johnson Space Center, USA; Mosier, Benjamin, Inventor, NASA Johnson Space Center, USA; Cassanto, John M., Inventor, NASA Johnson Space Center, USA; Apr. 10, 2001; 24p; In English; Continuation-in-part of US-Patent-Appl-SN-349169, filed 2 Dec. 1994
Patent Info.: Filed 15 May 1998; NASA-Case-MSC-22937-1; US-Patent-6,214,300; US-Patent-Appl-SN-079833; US-Patent-Appl-SN-349169; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A microencapsulation and electrostatic processing (MEP) device is provided for forming microcapsules. In one embodiment, the device comprises a chamber having a filter which separates a first region in the chamber from a second region in the chamber. An aqueous solution is introduced into the first region through an inlet port, and a hydrocarbon/ polymer solution is introduced into the second region through another inlet port. The filter acts to stabilize the interface and suppress mixing between the two immiscible solutions as they are being introduced into their respective regions. After the solutions have been introduced and have become quiescent, the interface is gently separated from the filter. At this point, spontaneous formation of microcapsules at the interface may begin to occur, or some fluid motion may be provided to induce microcapsule formation. In any case, the fluid shear force at the interface is limited to less than 100 dynes/sq cm. This low-shear approach to microcapsule formation yields microcapsules with good sphericity and desirable size distribution. The MEP device is also capable of downstream processing of microcapsules, including rinsing, re-suspension in tertiary fluids, electrostatic deposition of ancillary coatings, and free-fluid electrophoretic separation of charged microcapsules.
Official Gazette of the U.S. Patent and Trademark Office
Electrostatics; Encapsulating; Liquid-Liquid Interfaces

20010055245 Southwest Research Inst., San Antonio, TX USA
Laboratory Experimentation Model of the 270 Degree Electron Tophat Analyzer ***Annual Report***
Frahm, R. A., Southwest Research Inst., USA; Sharber, J. R., Southwest Research Inst., USA; Link, R., Southwest Research Inst., USA; Winningham, J. D., Southwest Research Inst., USA; Mar. 31, 2001; 19p; In English
Contract(s)/Grant(s): NAG5-8515; SwRI Proj. 15-02992; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

One of the most important space plasma measurements is that of a well-resolved low-energy (approximately 1 eV to 1 keV) electron spectrum. This range includes the regime where photoelectron and Auger processes are important as well as the very low energy range (down to 1 eV) where electron distributions of temperature 11,000 K are measurable. Knowledge of the structure

(approx. eV scale) of the photoelectron spectrum can provide information on the composition of a planetary or cometary atmosphere. As evidence, scientists developing the Analyzer of Space Plasma and Energetic Atoms (ASPERA-3) Electron Spectrometer (ELS) flying on the European Space Agency (ESA) Mars Express Mission have adapted their electron instrument to increase energy resolution in the photoelectron energy region as a means of remotely sensing the Martian atmosphere; the idea being that the Martian magnetic field is so weak that electron interaction between the source and point of detection is nonexistent; the measured electrons are therefore reflective of the processes occurring in the Martian atmosphere.
Author
Photoelectrons; Space Plasmas; Remote Sensing; Spacecraft Instruments

20010055269 NASA Pasadena Office, CA USA
High-Resolution Large-Field-of-View Three-Dimensional Hologram Display System and Method Thereof
Chao, Tien-Hsin, Inventor, Jet Propulsion Lab., California Inst. of Tech., USA; Mintz, Frederick W., Inventor, Jet Propulsion Lab., California Inst. of Tech., USA; Tsou, Peter, Inventor, Jet Propulsion Lab., California Inst. of Tech., USA; Bryant, Nevin A., Inventor, Jet Propulsion Lab., California Inst. of Tech., USA; Feb. 27, 2001; 8p; In English
Patent Info.: Filed 19 Jun. 1999; NASA-Case-NPO-20101-1-CU; US-Patent-6,195,184; US-Patent-Appl-SN-336542; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

A real-time, dynamic, free space-virtual reality, 3-D image display system is enabled by using a unique form of Aerogel as the primary display media. A preferred embodiment of this system comprises a 3-D mosaic topographic map which is displayed by fusing four projected hologram images. In this embodiment, four holographic images are projected from four separate holograms. Each holographic image subtends a quadrant of the 4(pi) solid angle. by fusing these four holographic images, a static 3-D image such as a featured terrain map would be visible for 360 deg in the horizontal plane and 180 deg in the vertical plane. An input, either acquired by 3-D image sensor or generated by computer animation, is first converted into a 2-D computer generated hologram (CGH). This CGH is then downloaded into large liquid crystal (LC) panel. A laser projector illuminates the CGH-filled LC panel and generates and displays a real 3-D image in the Aerogel matrix.
Author
Holography; Display Devices; Aerogels; Virtual Reality

20010055672 Naval Air Warfare Center, Aircraft Div., Patuxent River, MD USA
5700 A/AN Lessons Learned
Abercrombie, Kevin; Aug. 02, 2001; 6p; In English
Report No.(s): AD-A388945; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The Fluke 5700A/AN meter calibrator is a precision instrument designed to calibrate general purpose measuring and test equipment It provides a source of direct and alternating voltage, direct and alternating current, and resistance This unit is highly accurate and very user friendly, and because of these reasons, it was selected as the standard meter calibrator for use throughout the NAVAIR Metrology and Calibration (METCAL) program. Furthermore, because of its versatility, NAVAIR does not limit the use of the 5700A/AN to solely calibrating meters, it is also used in the calibration of other Ground Support Equipment (GSE) and General Purpose Electronic Test Equipment (GPETE). In all, the 5700A/AN meter calibrator is used in approximately 480 Instrument Calibration Procedures (ICPs). This paper describes the data collection method used to acquire failure information, the investigation into the failures of seven 5700A/AN meter calibrators, and the lessons learned as a result of the investigation. Finally, this paper contains recommendations for utilizing the 5700A/AN, which includes revisions to ICPs, appropriate safeguards, and good measurement practices.
DTIC
Calibrating; Measuring Instruments

20010057288 NASA Langley Research Center, Hampton, VA USA
Development of a Neutron Spectrometer to Assess Biological Radiation Damage Behind Spacecraft Materials
Maurer, R. H., Johns Hopkins Univ., USA; Kinnison, J. D., Johns Hopkins Univ., USA; Roth, D. R., Johns Hopkins Univ., USA; Miller, J., California Univ., Lawrence Berkeley Lab., USA; Heilbronn, L., California Univ., Lawrence Berkeley Lab., USA; Zeitlin, C., California Univ., Lawrence Berkeley Lab., USA; Singleterry, R., NASA Langley Research Center, USA; Microgravity Materials Science Conference 2000; March 2001; Volume 2, pp. 419-421; In English; See also 20010057256; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A01, Hardcopy

Astronauts who spend months and years traveling long distances in spacecraft and working on other planets will be subjected to high energy radiation of galactic and solar origin without the protection of the Earth's thick (one writer has called it buff) atmosphere and magnetic field. The lack of natural protection will allow high energy cosmic ray particles and solar protons to

crash directly into relatively thin spacecraft walls and planetary atmospheres producing energetic secondary particles in these collisions. A substantial fraction of these secondaries will be neutrons that carry no electric charge and, consequently, are difficult to detect. At sea level on Earth the remaining neutrons are the result of many generations (approximately 10) of collisions, have very low energies (scientists call them thermal neutrons), and do not penetrate deeply into the human body. They do contribute to the natural background radiation seen by humans on Earth, but much of the dose is only at the surface or skin of the body. In the International Space Station or on the surface of Mars, the secondary neutrons will be the result of only one or two generations of interaction due to the thinner (about a factor of 20 compared to the Earth's atmosphere) walls or atmosphere, have considerably more energy and penetrate deeply into the human body. In addition, neutrons are substantially moderated by hydrogenous material such as water. A significant fraction of the water exists in the astronaut's body. Therefore, the neutron can not only penetrate more deeply into the body, but also be stopped there and deposit all or most of its radiation dose in organs such as the liver, spleen, kidney, etc. We hypothesize that the risk of serious cancers will be increased for the exposed humans. The portable, real time neutron spectrometer being developed by our team will monitor the environment inside spacecraft structures and on planetary surfaces. Activities supported by this grant will evaluate the neutron environment inside several candidate spacecraft materials at accelerator facilities. These experiments will enable engineers to choose the structure materials that minimize the production of secondary neutrons. With the information that the neutron energy spectrometer produces, scientists and doctors will be able to assess the increased risk of cancer and develop countermeasures. The instrument itself will include an alarm system to warn astronauts when high radiation fluxes are occurring so that they can seek shelter immediately.
Author
Neutron Spectrometers; Portable Equipment; Radiation Damage; Spacecraft Structures; Thermal Neutrons; Cosmic Rays; Human Body; Long Duration Space Flight; Extraterrestrial Environments; Aerospace Medicine; Biological Effects

20010057325 NASA Marshall Space Flight Center, Huntsville, AL USA
SHIVA-(Spaceflight Holography in a Virtual Apparatus)
Trolinger, James D., MetroLaser, USA; LaI, Ravindra B., Alabama A & M Univ., USA; Rangel, Roger, California Univ., USA; Coimbra, Carlos, Drexel Univ., USA; Witherow William, NASA Marshall Space Flight Center, USA; Rogers, Jan, NASA Marshall Space Flight Center, USA; Microgravity Materials Science Conference 2000; March 2001; Volume 3, pp. 599-607; In English; See also 20010057302; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A02, Hardcopy

SHIVA (Spaceflight Holography Investigation in a Virtual Apparatus) will expand our understanding of the fundamental physics of particle movement in fluids by exploiting the power of holography in a spaceflight experiment'. In addition, the study will exploit the movement of particles in fluids to observe and quantify microgravity phenomena that are extremely important in materials sciences with applications both in space and on earth. The regime under scrutiny is the low Reynolds number, Stokes regime or creeping flow, which covers particles and bubbles moving at very low velocity. The equations describing this important regime have been under development and investigation for over 100 years and yet a complete analytical solution of the general equation had remained elusive yielding only approximations and numerical solutions. In the course of the ongoing NASA NRA, the first analytical solution of the general equation was produced by members of the investigator team using the mathematics of fractional derivatives. This opened the way to an even more insightful and important investigation of the phenomena in microgravity.
Author
Holography; Particle Motion; Low Reynolds Number

20010058974 Queens Univ., Dept. of Mechanical Engineering, Kingston, Ontario Canada
Accuracy of the Iscan Pressure Measurement System
Wilson, David R., Queens Univ., Canada; Eichler, Mark J., Beth Israel Deaconess Medical Center, USA; Hayes, Wilson C., Beth Israel Deaconess Medical Center, USA; Soldier Mobility: Innovations in Load Carriage System Design and Evaluation; May 2001, pp. 23-1 - 23-4; In English; See also 20010058955; Copyright Waived; Avail: CASI; A01, Hardcopy

The Iscan system can be used to measure continuously changing force and pressure distribution at biomechanical interfaces. The objective of this study was to determine how accurately the Iscan system measures force and force distribution in static loading. Known absolute and relative loads were applied to Iscan sensors using custom-built indentors loaded in a servohydraulic test machine. Over the 35 trials, the mean error for the absolute measurement of force was 6.5% and the standard deviation of the error was 4.4%. The mean error in the force distribution measurement over the 25 trials was 0.86% and the standard deviation

of the error was 0.58%. The results suggest that, when calibration, conditioning and testing protocols are developed carefully, the Iscan system measures force and pressure distribution more accurately than Fuji Prescale film.
Author
Force Distribution; Pressure Distribution; Pressure Measurement; Weight (Mass); Accuracy

20010059241 NASA Langley Research Center, Hampton, VA USA
Test Cases for Modeling and Validation of Structures with Piezoelectric Actuators
Reaves, Mercedes C., NASA Langley Research Center, USA; Horta, Lucas G., NASA Langley Research Center, USA; [2001]; 11p; In English; 42nd AIAA/ASME/ASCE/AHS/ASC Structure and Structural Dynamics Conference, 16-19 Apr. 2001, Seattle, WA, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Report No.(s): AIAA Paper 2001-1466; Copyright Waived; Avail: CASI; A03, Hardcopy; A01, Microfiche

A set of benchmark test articles were developed to validate techniques for modeling structures containing piezoelectric actuators using commercially available finite element analysis packages. The paper presents the development, modeling, and testing of two structures: an aluminum plate with surface mounted patch actuators and a composite box beam with surface mounted actuators. Three approaches for modeling structures containing piezoelectric actuators using the commercially available packages: MSC/NASTRAN and ANSYS are presented. The approaches, applications, and limitations are discussed. Data for both test articles are compared in terms of frequency response functions from deflection and strain data to input voltage to the actuator. Frequency response function results using the three different analysis approaches provided comparable test/analysis results. It is shown that global versus local behavior of the analytical model and test article must be considered when comparing different approaches. Also, improper bonding of actuators greatly reduces the electrical to mechanical effectiveness of the actuators producing anti-resonance errors.
Author
Piezoelectric Actuators; Mathematical Models; Finite Element Method; Electric Potential; Piezoelectricity

20010059875 Defence Science and Technology Organisation, Maritime Platforms Div., Fishermans Bend, Australia
A Digital Recording System for Shock Induced Motion
McLean, Andrew, Defence Science and Technology Organisation, Australia; Box, Phillip, Defence Science and Technology Organisation, Australia; March 2001; 10p; In English
Report No.(s): DSTO-TN-0339; DODA-AR-011-799; Copyright; Avail: Issuing Activity

A digital data recording system capable of recording signals from various types of transducers used to measure shock motion is described. The methods used to maximize the flexibility of the recording system and the methodology to optimize the data obtained is explained.
Author
Data Recording; Digital Systems; Magnetic Recording; Shock Measuring Instruments

36
LASERS AND MASERS

Includes lasing theory, laser pumping techniques, maser amplifiers, laser materials, and the assessment of laser and maser outputs. For cases where the application of the laser or maser is emphasized see also the specific category where the application is treated. For related information see also 76 Solid-State Physics.

20010055270 NASA Lewis Research Center, Cleveland, OH USA
Selective Emitter Pumped Rare Earth Laser
Chubb, Donald L., Inventor, NASA Lewis Research Center, USA; Patton, Martin O., Inventor, NASA Lewis Research Center, USA; Mar. 06, 2001; 4p; In English
Patent Info.: Filed 27 May 1999; NASA-Case-LEW-16681-1; US-Patent-6,198,760; US-Patent-Appl-SN-332249; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

A selective emitter pumped rare earth laser provides an additional type of laser for use in many laser applications. Rare earth doped lasers exist which are pumped with flashtubes or laser diodes. The invention uses a rare earth emitter to transform thermal energy input to a spectral band matching the absorption band of a rare earth in the laser in order to produce lasing.
Official Gazette of the U.S. Patent and Trademark Office
Lasers; Emitters

37
MECHANICAL ENGINEERING

Includes mechanical devices and equipment; machine elements and processes. For cases where the application of a device or the host vehicle is emphasized see also the specific category where the application or vehicle is treated. For robotics see 63 Cybernetics, Artificial Intelligence, and Robotics; and 54 Man/System Technology and Life Support.

20010054737 NASA Johnson Space Center, Houston, TX USA
Manually Operated Welding Wire Feeder
Rybicki, Daniel J., Inventor, NASA Johnson Space Center, USA; Apr. 10, 2001; 8p; In English
Patent Info.: Filed 15 Sep. 1999; NASA-Case-MSC-23026-1; US-Patent-6,213,375; US-Patent-Appl-SN-408649; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

A manual welding wire feeder apparatus comprising a bendable elongate metal frame with a feed roller mounted at the center thereof for rotation about an axis transverse to the longitudinal axis of the frame. The frame ends are turned up as tabs and each provided with openings in alignment with each other and the mid-width center of the roller surface. The tab openings are sized to accommodate welding wire and each extends to a side edge of the tab, both opening on the same side of the frame, whereby welding wire can be side-loaded onto the frame. On the side of the frame, opposite the roller a lock ring handle is attached tangentially and is rotatable about the attachment point and an axis perpendicular to the frame. The device is grasped in the hand normally used to hold the wire. A finger is placed through the loop ring and the frame positioned across the palm and lower fingers. The thumb is positioned atop the wire so it can be moved from the back of the frame across the roller, and towards the front. In doing so, the wire is advanced at a steady rate in axial alignment with the tab openings and roller. to accommodate different wire diameters the frame is bendable about its center in the plane of the frame axis and wire so as to keep the wire in sufficient tension against the roller and to keep the wire fixed when the frame is tilted and thumb pressure released.
Official Gazette of the U.S. Patent and Trademark Office
Wire; Welding; Feeders

20010054960 Maribor Univ., Fakulteta za Elektrotehniko Racunalnistvo in informatiko, Maribor, Slovenia
Analysis of the Laboratory Implementation of Radial Active Magnetic Bearing ***Analiza laboratorijske izvedbe radialnega aktivnega magnetnega lezaja***
Polajzer, Bostjan, Maribor Univ., Slovenia; Stumberger, Gorazd, Maribor Univ., Slovenia; Dolinar, Drago, Maribor Univ., Slovenia; Hameyer, Kay, Katholieke Univ. te Leuven, Belgium; Electrotechnical Review; 2001; ISSN 0013-5852; Volume 68, No. 1, pp. 64-69; In Slovene; Copyright; Avail: Issuing Activity

Magnetic bearings are technical applications of a stable rotor levitation. All six degrees of freedom of the levitating body should be controlled, which is not possible by using permanent magnets only. Though there are several principles of magnetic bearings known, the principles based on controlled electromagnetic circuits to provide the attractive force are the ones that are in common use. Two electromagnets on the opposite sides of the ferromagnetic rotor pull the rotor in the opposite directions. As such a system is unstable, therefore a rotor position control is required. Bearings using this principle are called active magnetic bearings (AMB). AMB consist of two radial bearings, each controlling the motion of the rotor shaft in vertical and horizontal direction. Stabilization of the shaft in axial direction is achieved by the axial bearing while the shaft rotation is controlled by an independent driving motor. Due to their non-contact operation, AMB offer significant advantages. Higher speed, no friction, no lubrication, precise position control and active vibration damping make them particularly appropriate for high-speed rotating machines. Technical applications include pumps, centrifuges and precise machine tools. The control design, as well as stability and robustness of the controlled AMB, are strongly dependent on the bearing statics and dynamic properties. Therefore, the knowledge of the force characteristic and parameters of the linearized mathematical model are matters of great importance for the entire operating range. The finite element method, as well as measurements, may be a very helpful tool for their determination. In this work, an analysis of the radial AMB is given. At the beginning, a laboratory implementation of the magnetic bearing is briefly described. In order to linearize force-current relation and to obtain a SISO system, a differential driving mode is introduced. Also, the linearized model is given together with a definition of two parameters, i.e. the current gain and the position stiffness. Furthermore, two procedures for the force characteristic determination are described. First, the finite element method is used where the force is calculated by the Maxwell's stress tensor method using. Second, the experimental procedure is presented. As a result, a comparison of the calculated and measured force characteristic is made. At the end, the current gain and position stiffness are determined in the entire operating range. The agreement between the calculated results and measured values is very good in

the whole operating range. In future, the obtained results will be applied in the robust control design with a linearization in the entire operating range.
Author
Ferromagnetic Materials; Finite Element Method; Levitation; Magnetic Bearings; Mathematical Models

20010055266 NASA Lewis Research Center, Cleveland, OH USA
Wave Augmented Diffuser for Centrifugal Compressor
Skoch, Gary J., Inventor, NASA Lewis Research Center, USA; Paxson, Daniel E., Inventor, NASA Lewis Research Center, USA; Mar. 13, 2001; 15p; In English
Patent Info.: Filed 18 Jun. 1999; NASA-Case-LEW-16644-1; US-Patent-6,200,094; US-Patent-Appl-SN-350207; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A wave augmented diffuser for a centrifugal compressor surrounds the outlet of an impeller that rotates on a drive shaft having an axis of rotation. The impeller brings flow in in an axial direction and imparts kinetic energy to the flow discharging it in radial and tangential directions. The flow is discharged into a plurality of circumferentially disposed wave chambers. The wave chambers are periodically opened and closed by a rotary valve such that the flow through the diffuser is unsteady. The valve includes a plurality of valve openings that are periodically brought into and out of fluid communication with the wave chambers. When the wave chambers are closed, a reflected compression wave moves upstream towards the diffuser bringing the flow into the wave chamber to rest. This action recovers the kinetic energy from the flow and limits any boundary layer growth. The flow is then discharged in an axial direction through an opening in the valve plate when the valve plate is rotated to an open position. The diffuser thus efficiently raises the static pressure of the fluid and discharges an axially directed flow at a radius that is predominantly below the maximum radius of the diffuser.
Official Gazette of the U.S. Patent and Trademark Office
Centrifugal Compressors; Flow Chambers; Diffusers

20010056398 NASA Johnson Space Center, Houston, TX USA
Compact, Stiff, Remotely-Actuable Quick-Release Clamp
Tsai, Ted W., Inventor, NASA Johnson Space Center, USA; Dec. 12, 2000; 13p; In English
Patent Info.: Filed 24 Nov. 1998; NASA-Case-MSC-22722-1; US-Patent-6,158,729; US-Patent-Appl-SN-208800; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The present invention provides a clamp that is compact and lightweight, yet provides high holding strength and stiffness or rigidity. The clamp uses a unique double slant interface design which provides mechanical advantages to resist forces applied to the clamp member as the load increases. The clamp allows for rapid and remote-activated release of the clamp jaws by applying only a small operating force to an over-center lock/release mechanism, such as by pulling a manual tether.
Official Gazette of the U.S. Patent and Trademark Office
Clamps; High Strength; Remote Control

20010057275 Wisconsin Univ., Dept. of Materials Science and Engineering, Madison, WI USA
Experiments to Observe Marangoni Convection in Simulated Weld Pools and Its Effect on the Weld Pool Shape
Limmaneevichitr, C., Wisconsin Univ., USA; Kou, S., Wisconsin Univ., USA; Microgravity Materials Science Conference 2000; March 2001; Volume 2, pp. 366-371; In English; See also 20010057256; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A02, Hardcopy

A transparent pool of sodium nitrate (NaNO3) was heated with a defocused CO2 laser beam to simulate Marangoni convection in arc weld pools without a surface-active agent. The flow patterns were revealed by flow visualization with a laser light-cut technique. The observed Marangoni convection was expected to resemble that in welding because the Marangoni number was close to those in welding. The maximum velocity was at the pool surface, the outward surface flow was much faster than the inward return flow, and the centers of the cells were near the pool edge. These characteristics suggest Marangoni convection dominate in the pool over buoyancy convection. The results of flow visualization provided interesting insights for understanding the significant effect of Marangoni convection on the weld pool shape, as demonstrated in stationary welds of NaNO3 (a high Prandtl number material) and Ga (a low Prandtl number material). Both the flat and convex pool bottoms are a clear indication that Marangoni convection dominated over buoyancy convection. It is proposed that, unless a surface-active agent or a significant electromagnetic force is present, pool bottom convexity increases with increasing Peclet number.
Author
Marangoni Convection; Flow Visualization

20010057340 Pennsylvania State Univ., Dept. of Materials Science and Engineering, University Park, PA USA

Gravitational Effects on the Weld Pool Geometry During Gas Tungsten Arc and Laser Welding

Kang, Nam Hyun, Pennsylvania State Univ., USA; Kulkarni, Anil K., Pennsylvania State Univ., USA; Singh, Jogender, Pennsylvania State Univ., USA; Microgravity Materials Science Conference 2000; March 2001; Volume 3, pp. 543-547; In English; See also 20010057302; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A01, Hardcopy

A welding process needs more precise understanding of free surface geometry and corresponding shape of the weld pool during melting and solidification. In normal earth gravity, surface tension gradient driven flow has been determined to be the dominant force and gravity driven force has been treated as a minimal factor for a melt convection. However, the high pressure at the center of an arc causes the pool center to be depressed and its edges to be risen by the surrounding solid around the weld pool. Authors' preliminary investigation shows that the gravitational force can considerably affect the surface deformation of the liquid metal. The scientific and technological benefits of this investigation are to understand the nature of the gravitational effects on the welding convection flows and the free surface deformation. The long-term goal is to optimize future applications in predicting the geometry of the weld pool in normal Earth gravity and microgravity.

Author

Gravitational Effects; Convection; Gas Tungsten Arc Welding; Welding; Shapes; Microgravity

20010057773 NASA Langley Research Center, Hampton, VA USA

Studies of the Retardation Force Developed on an Aircraft Tire Rolling in Slush or Water

Horne, Walter B., NASA Langley Research Center, USA; Joyner, Upshur T., NASA Langley Research Center, USA; Leland, Trafford J. W., NASA Langley Research Center, USA; September 1960; 38p; In English

Report No.(s): NASA-TN-D-552; L-1260; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A series of unbraked (freely rolling) taxi tests were conducted at the Langley landing-loads track with a 32 x 8.8, type 7, 22-ply-rating ribbed-tread aircraft tire to obtain data on tire retardation forces developed during rolling in both slush and water. The forward speeds of the tests ranged from 59 to 104 knots. Tire inflation pressures of 350 and 115 pounds per square inch were used. Results indicated a parabolic increase of retardation force with increasing forward velocity for both slush- and water-covered runway surfaces. The retardation force was found to increase approximately linearly with increasing water depth. Drag coefficients appropriate to the equations used are presented. Calculations made to determine the effect of slush on the take-off distance of a jet transport are in agreement with data obtained from an actual take-off in slush for this airplane. This is an interim report which deals with the effect of slush on the acceleration and the ground-run distance of airplanes during take-off.

Author

Aerodynamic Coefficients; Aerodynamic Drag; Aircraft Tires; Runways; Takeoff; Retarding

20010058683 NASA Glenn Research Center, Cleveland, OH USA

Dynamic Stiffness and Damping Characteristics of a High-Temperature Air Foil Journal Bearing

Howard, Samuel A., NASA Glenn Research Center, USA; DellaCorte, Christopher, NASA Glenn Research Center, USA; Valco, Mark J., Army Research Lab., USA; Prahl, Joseph M., Case Western Reserve Univ., USA; Heshmat, Hooshang, Mohawk Innovative Technology, Inc., USA; [2001]; 23p; In English; International Joint Tribology Conference, 21-24 Oct. 2001, San Francisco, CA, USA

Contract(s)/Grant(s): RTOP 708-1B-13; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Using a high-temperature optically based displacement measurement system, a foil air bearing's stiffness and damping characteristics were experimentally determined. Results were obtained over a range of modified Sommerfeld Number from 1.5E6 to 1.5E7, and at temperatures from 25 to 538 C. An Experimental procedure was developed comparing the error in two curve fitting functions to reveal different modes of physical behavior throughout the operating domain. The maximum change in dimensionless stiffness was 3.0E-2 to 6.5E-2 over the Sommerfeld Number range tested. Stiffness decreased with temperature by as much as a factor of two from 25 to 538 C. Dimensionless damping was a stronger function of Sommerfeld Number ranging from 20 to 300. The temperature effect on damping being more qualitative, showed the damping mechanism shifted from viscous type damping to frictional type as temperature increased.

Author

Foil Bearings; High Temperature Air; Viscous Damping; Dynamic Characteristics; Temperature Effects; Airfoils; Stiffness

38
QUALITY ASSURANCE AND RELIABILITY

Includes approaches to, and methods for reliability analysis and control, inspection, maintainability, and standardization.

20010055653 Southern Taiwan Univ. of Tech., Dept. of Industrial Management, Tainan, Taiwan, Province of China
Integrating an EMQ Model and Product Quality
Chen, Chung-Ho, Southern Taiwan Univ. of Tech., Taiwan, Province of China; Chou, Chao-Yu, National Yun-Lin Univ. of Science and Technology, Taiwan, Province of China; Journal of the Chinese Institute of Engineers; March 2001; ISSN 0253-3839; Volume 24, No. 2, pp. 269-272; In English; Copyright; Avail: Issuing Activity

In this paper we further extend Chen and Wang's study concerning a CSP-1 plan applied to the economic manufacturing quantity (EMQ) model with imperfect quality. Adopting the backorder assumption for shortages, the modified total inventory cost includes the setup cost, the holding cost, the backordering cost, the inspection cost, and the internal and external failure cost. by solving the modified EMQ model, we not only obtain the required level of product quality but also determine the minimum of the total inventory cost.
Author
Economics; Manufacturing; Sampling; Quality

20010059325 Illinois Univ., Dept. of Mechanical and Industrial Engineering, Urbana, IL USA
Thermoelastic Non-Destructive Evaluation of Structural Materials ***Final Report, Jun. 1999***
Mackin, Thomas J., Illinois Univ., USA; Jun. 1999; 12p; In English
Contract(s)/Grant(s): F49620-99-1-0215
Report No.(s): AD-A388637; No Copyright; Avail: CASI; A01, Microfiche; A03, Hardcopy

The research was conducted to demonstrate that a new NDE method based upon thermoelasticity can be utilized to quantify damage in composite materials, to identify damage mechanism, and to be generally applicable as a lifetime prediction tool. Funding from the DURIP award was used to purchase an IR camera system and a photoelastic imaging system. The IR camera is a Stress Photonics DeltaTherm1OOO closed cycle cooled system with a temperature resolution of 0.003K at a spatial resolution of 120 microns. A sapphire zoom lens was purchased to improve the resolution to 20 microns. A broad range of experiments were carried out to characterize local damage and stress concentrations in several composite systems. Experimental measurements of damage and the resulting stress distributions across the surface of test specimens were used to quantify damage evolution in each composite material. Damage evolution was quantified by using experimental measures of stress concentration factors derived from the observed IR signal. These measures of damage were used to relate changes in the composite properties to the experimentally measured stress redistribution. We found that the system could identify the operative damage mechanism, the current state of damage, and predict the residual fatigue lifetime of the tested materials. As a result, a new method has been developed for evaluating and tracking damage in composite materials and for accurately predicting the remaining service lifetimes of those materials.
DTIC
Nondestructive Tests; Composite Materials; Construction Materials; Thermoelasticity

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STRUCTURAL MECHANICS

Includes structural element design, analysis and testing; dynamic responses of structures; weight analysis; fatigue and other structural properties; and mechanical and thermal stresses in structure. For applications see 05 Aircraft Design, Testing and Performance and 18 Spacecraft Design, Testing and Performance.

20010055637 National Yun-Lin Univ. of Science and Technology, Dept. of Mechanical Engineering, Touliu, Taiwan, Province of China
Using Finite Element Analysis/Optimum Design in the Determination of Elastic Constants by Vibration Testing
Hwang, Shun-Fa, National Yun-Lin Univ. of Science and Technology, Taiwan, Province of China; Chang, Chao-Shui, National Yun-Lin Univ. of Science and Technology, Taiwan, Province of China; Journal of the Chinese Institute of Engineers; March 2001; ISSN 0253-3839; Volume 24, No. 2, pp. 253-260; In English; Copyright; Avail: Issuing Activity

Combining vibration testing and numerical methods is a potential alternative approach for determining elastic constants of materials because of nondestructive testing, single testing, and producing average properties. In order to simplify the modeling processes and to reduce complicated derivations in the numerical method, the combination of finite element analysis and optimum

design is adopted in this work to inversely calculate the elastic constants. In this method, the effects of some parameters, including the finite element mesh, the mode number, constraints on state variables, the optimization method, and initial values and loops, are discussed. It is proved that the present method with 10x10 mesh, 6 vibration modes, 5% constraint on state variables, and subproblem approximation can obtain accurate results. Average values can be used to avoid the scatter in results due to different initial values, and do-loops may not be necessary. It is also clearly demonstrated that the present method can correctly extract 2 or 5 elastic constants for isotropic or orthotropic materials.
Author
Finite Element Method; Optimization; Design Analysis

20010055657 National Cheng Kung Univ., Dept. of Civil Engineering, Tainan, Taiwan, Province of China
An Analytical Study of Axle Load Equivalency Factors of Concrete Pavements
Kuo, Chen-Ming, National Cheng Kung Univ., Taiwan, Province of China; Lin, Shen-Hsian, National Cheng Kung Univ., Taiwan, Province of China; Journal of the Chinese Institute of Engineers; March 2001; ISSN 0253-3839; Volume 24, No. 2, pp. 119-130; In English; Copyright; Avail: Issuing Activity

The concept of single axle load equivalency factor (LEF) was reviewed and an in-depth study was focused on the idea of equivalent single axle load (ESAL) developed by American Association of State Highway officials (AASHO), A three-dimensional finite element model was utilized to simulate the AASHO Road Test pavement sections and to develop LEF formulae for various pavement sections under various axle loadings. The characteristics of the mechanistic-empirical derived LEF formula were examined through the viewpoints of pavement structural factors. Comparing the current American Association of State Highway and Transportation Officials (AASHTO) Design Guide, additional effect of base courses, joint devices, and subgrade strength were found for rigid pavement thickness design. Adequacy of traffic equivalency estimation for a specific pavement structure can be enhanced through the proposed LEF regression formula. The design example also showed that the current LEF tables in the AASHTO Design Guide resulted in lower ESALs than those from the proposed LEF formula for pavements with cement-treated and bituminous-treated bases.
Author
Loads (Forces); Concretes; Pavements; Equivalence

20010055661 National Taiwan Ocean Univ., Dept. of System Engineering and Naval Architecture, Keelung, Taiwan, Province of China
Applications of Domain Partition in BEM for Solving the Vibration Problem of a Rod Subjected to a Spatially Distributed Harmonic Loading
Chang, Jiang-Ren, National Taiwan Ocean Univ., Taiwan, Province of China; Yeih, Wei-Chung, National Taiwan Ocean Univ., Taiwan, Province of China; Journal of the Chinese Institute of Engineers; March 2001; ISSN 0253-3839; Volume 24, No. 2, pp. 151-171; In English; Copyright; Avail: Issuing Activity

In this paper, the dual boundary element method is used in conjunction with the domain partition to solve the vibration problem for a rod subjected to a time harmonic loading. It is shown that when the constraint equations are all included in the solver and the real part singular or real part hypersingular equation is used alone, the spurious resonance that may arise can be eliminated by using the singular value decomposition method. Even when the complex singular or hypersingular equation is used, if the structure is complicated or heterogeneous, domain partitioning and a subsequent parallel treatment become necessary, this gives rise to both spurious and ”pseudo-spurious” resonance. Three iteration schemes that are often used in parallel computation are shown to be inadequate here, and a new ”mixed method” approach is proposed. Three benchmark examples are then used to show how the proposed approaches can be applied to eliminate various kinds of spurious and pseudo-spurious resonance.
Author
Partitions (Mathematics); Boundary Element Method; Vibration

20010055682 Lehigh Univ., Bethlehem, PA USA
Cracking of a Graded Half Plane Due to Sliding Contact
Erdogan, Frazil; Dag, Serkan; Mar. 2001; 95p; In English
Contract(s)/Grant(s): F49620-98-1-0028
Report No.(s): AD-A389046; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

In this report the initiation and subcritical growth of surface cracks in graded materials due to sliding contact are considered. After a brief introduction the general coupled crack/contact problem for a semi-infinite graded medium subjected to a sliding rigid stamp of arbitrary profile is formulated. Solving the problem in the absence of any cracks, the complete stress state on the surface

of the medium is evaluated and critical stress that would cause surface crack initiation is identified. The coupled problem is then solved, stress intensity factors are calculated and some results are presented.
DTIC
Stress Intensity Factors; Surface Cracks; Sliding Friction; Crack Initiation; Crack Propagation

20010057238 Ohio State Univ., Dept. of Chemistry, USA
Fundamental Studies of Crystal Growth of Microporous Materials
Dutta, Prabir K., Ohio State Univ., USA; Microgravity Materials Science Conference 2000; March 2001; Volume 1, pp. 199-203; In English; See also 20010057199; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A01, Hardcopy

Microporous materials include a large group of solids of varying chemical composition as well as porosity. These materials are characterized by channels and cavities of molecular dimensions. The framework structure is made up of interconnecting T-O-T' bonds, where T and T' can be Si, Al, P, Ga, Fe, Co, Zn, B and a host of other elements, Materials with Si-O-Al bonding in the framework are called zeolites and are extensively used in many applications. Ion-exchange properties of these materials are exploited in the consumer and environmental industries. Chemical and petroleum industries use zeolites as catalysts in hydrocarbon transformations. Synthesis of new microporous frameworks has led to the development of new technologies, and thus considerable effort worldwide is expended in their discovery. Microporous materials are typically made under hydrothermal conditions. Influence of nature of starting reactants, structure directing agents, pH, temperature, aging all have profound influence on the synthesis process. This is primarily because the most interesting open frameworks are not necessarily the stable structures in the reaction medium. Thus, the discovery of new frameworks is often tied to finding the right composition and synthesis conditions that allow for kinetic stabilization of the structure. This complexity of the synthesis process and limited understanding of it has made it difficult to develop directed synthesis of microporous materials and most advances in this field have been made by trial and error. The basic issues in crystal growth of these materials include: Nature of the nucleation process, (1) Molecular structure and assembly of nuclei, (2) Growth of nuclei into crystals, (3) Morphology control, (4) Transformation of frameworks into other structures. The NASA-funded research described in this paper focuses on all the above issues and has been described in several publications. Below we present the highlights of our program, especially with the focus on possible experiments in microgravity.
Author
Crystal Growth; Microgravity; Microporosity; Porous Materials; Nucleation; Crystallization

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GEOSCIENCES (GENERAL)

Includes general research topics related to the Earth sciences, and the specific areas of petrology, mineralogy, and general geology. For other specific topics in geosciences see categories 41 through 48.

20010055574 FROM, Water Resources Div.
Water Resources Data New York Water Year 2000. Volume 2. Long Island ***Annual Report, (Annual) 1 Oct. 1999 - 30 Sep. 00***
Spinello, A. G.; Busciolano, R.; Pena-Cruz, G. P.; Winowitch, R. B.; Apr. 2001; 244p
Report No.(s): PB2001-105521; USGS/WDR-NY-00-2; No Copyright; Avail: CASI; A11, Hardcopy; A03, Microfiche

Water resources data for the 2000 water year for New York consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; stage and water quality of estuaries; and water levels and water quality of ground-water wells. This volume contains records for water discharge at 19 gaging stations; tide stage two gaging stations; and water levels at 447 observation wells. Additional water data were collected at various sites not involved in the systematic data collection program, and are published as miscellaneous measurements and analyses. These data, together with the data in Volume 1 and 3 represent that part of the National Water Data system operated by the US Geological Survey in cooperation with State, Federal, and other agencies in New York.
NTIS
Ground Water; Water Quality; Hydrology; Water Resources

20010055582 FROM

Revision of Middle Proterozic Yellowjacket Formation, Central Idaho, and Resision of Cretaceous Slim Sam Formation, Elkhorn Mountains Area, Montana

Tysdal, R. G.; Dec. 2000; 36p; In English

Report No.(s): PB2001-104830; USGS-PP-1601-A-B; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Contents include the following: Introduction; Stratigraphic Units: Yellowjackt-Quartzite Mountain-Iron Lake Area of Salmon River Mountains; Western part of Lemhi Range; Structural and Stratigraphic Patterns: Regional Patterns and Iron Lake Fault, Previous Stratigraphic Interpretations, and Age of the Yellowjacket Foundation (Restricted); Application to Stratabound Mineralization; Conclusions; Reference Cited; and Addendum.

NTIS

Stratigraphy; Geological Faults; Formations

20010055584 FROM, Water Resources Div.

Water Resources Data for California Water Year 2000. Volume 1. Southern Great Basin from Mexican Border to Mono Lake Basin, and Pacific Slope Basins from Tijuana River to Santa Maria River ***Annual Report, (Annual) 1 Oct. 1999 - 30 Sep. 00***

Anderson, S. W.; Agajanian, J.; Rockwell, G. L.; May 2001; 506p; In English

Report No.(s): PB2001-105368; USGS/WDR/CA-00/1; No Copyright; Avail: CASI; A22, Hardcopy; A04, Microfiche

Water-resources data for the 2000 water year for California consist of records of stage, discharge, and water quality of streams, stage and contents in lakes and reservoirs, and water levels and water quality in wells. Volume 1 contains discharge records for 175 gaging stations and 13 crest-stage partial-record stations, stage and contents for 20 lakes and reservoirs, gage-height records for two stations, water quality for 27 streamflow-gaging stations and three partial-record stations, and precipitation data for four stations. These data represent that part of the National Water Data System operated by the US Geological Survey and cooperating State and Federal agencies in California.

NTIS

Water Resources; Ground Water; Hydrology; Water Quality

20010055592 Old Dominion Univ., Dept. of Ocean, Earth and Atmospheric Sciences, Norfolk, VA USA

Studying Earth's Environment From Space: Classroom and Laboratory Activities with Instructor Resources ***Final Report, 1 Jun. 1997 - 31 Dec. 2000***

Smith, Elizabeth A., Old Dominion Univ., USA; [2001]; In English; CD-ROM contains full text document in PDF format; CD compatible with MAC and IBM platforms

Contract(s)/Grant(s): NAG5-4515; ODURF Proj. 164191

Report No.(s): NONP-NASA-CD-2001086807; No Copyright; Avail: CASI; C01, CD-ROM

Standard, text-book based learning for earth, ocean, and atmospheric sciences has been limited by the unavailability of quantitative teaching materials. While a descriptive presentation, in a lecture format, of discrete satellite images is often adequate for high school classrooms, this is seldom the case at the undergraduate level. In order to address these concerns, a series of numerical exercises for the Macintosh was developed for use with satellite-derived Sea Surface Temperature, pigment and sea ice concentration data. Using a modified version of NIH Image, to analyze actual satellite data, students are able to better understand ocean processes, such as circulation, upwelling, primary production, and ocean/atmosphere coupling. Graphical plots, image math, and numerical comparisons are utilized to substantiate temporal and spatial trends in sea surface temperature and ocean color. Particularly for institutions that do not offer a program in remote sensing, the subject matter is presented as modular units, each of which can be readily incorporated into existing curricula. These materials have been produced in both CD-ROM and WWW format, making them useful for classroom or lab setting. Depending upon the level of available computer support, graphics can be displayed directly from the CD-ROM, or as a series of color view graphs for standard overhead projection.

Author

Education; Earth Sciences; Numerical Analysis; Oceanography

20010056318 FROM, Water Resources Div.

Water Resources Data for Florida, Water Year 2000. Volume 1B. Northeast Florida Ground Water ***Annual Report, (Annual) 1 oct 1999 - 30 Sep. 00***

Apr. 2001; 292p

Report No.(s): PB2001-105522; USGS/WDR/FL-00/1B; No Copyright; Avail: CASI; A13, Hardcopy; A03, Microfiche

Water resources data for the 2000 water year in Florida consist of continuous or daily discharge for 355 streams, periodic discharge for 17 streams, continuous or daily stage for 211 streams, periodic stage for 1 stream, peak stage and discharge for 37 streams; continuous or daily elevations for 16 lakes, periodic elevations for 45 lakes; continuous ground-water levels for 393 wells, periodic ground-water levels for 1,003 wells; quality-of-water data for 124 surface-water sites and 244 wells. The data for northeast Florida include continuous or daily discharge for 145 streams, periodic discharge for 3 streams, continuous or daily stage for 21 streams, periodic stage for 0 streams; peak stage and discharge for 0 streams; continuous or daily elevations for 12 lakes, periodic elevations for 18 lakes; continuous ground water levels for 42 wells, periodic ground-water levels for 404 wells; quality-of-water data for 31 surface-water sites and 62 wells. These data represent the National Water Data System records collected by the U.S. Geological Survey and cooperating local, State and Federal agencies in Florida.
NTIS
Geological Surveys; Water Resources; Florida; Ground Water; Hydrology

20010056662 Geological Survey, Water Resources Div., Raleigh, NC USA
Water Resources Data for North Carolina, Water Year 2000, Volume 1B, Surface-Water Records ***Annual Report, 1 Oct. 1999 - 30 Sep. 2000***
Ragland, B. C., Geological Survey, USA; Barker, R. G., Geological Survey, USA; Robinson, J. B., Geological Survey, USA; Apr. 06, 2001; 628p; In English
Report No.(s): PB2001-105525; USGS/WDR-NC-00-1B; No Copyright; Avail: CASI; A99, Hardcopy; A06, Microfiche
Water-resources data for the 2000 water year for North Carolina consists of discharge records for 197 gaging stations; stage only records 52 gaging stations; stage and contents for 62 lakes and reservoirs; water quality for 66 gaging stations and 73 miscellaneous sites; continuous daily tide stage at 4 sites and continuous precipitation at 88 sites. Additional water data were collected at 61 sites not involved in the systematic data-collection program, and are published as miscellaneous measurements. Data contained in this volume includes discharge records for 136 gaging stations; stage and contents for 45 lakes and reservoirs; stage for 6 gaging stations; water quality for 19 gaging stations and 29 miscellaneous sites; continuous precipitation at 83 sites and miscellaneous measurements for 52 stations not involved in the systematic data-collection program.
NTIS
Data Acquisition; North Carolina; Water Resources; Surface Water; Hydrology; Ground Water

20010056664 Geological Survey, Water Resources Div., Helena, MT USA
Water Resources Data for Montana, Water Year 2000 ***Annual Report, 1 Oct. 1999 - 30 Sep. 2000***
Shields, R. R.; White, M. K.; Ladd, P. B.; Chambers, C. L.; Dodge, K. A.; Mar. 26, 2001; 660p; In English
Report No.(s): PB2001-105331; USGS/WDR/MT-00/1; No Copyright; Avail: CASI; A06, Microfiche; A99, Hardcopy
Water resources data for Montana for the 2000 water year consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels in wells. This report contains discharge records for 234 gaging stations; stage and/or content records for 8 lakes and large reservoirs and content for 31 smaller reservoirs; water-quality records for 105 streamflow stations (29 ungaged), 3 lakes, and 1 ground-water well; precipitation records for 2 atmospheric deposition stations; and water-level records for 47 observation wells. Additional water year 2000 data collected at crest-stage gage and miscellaneous measurement sites were collected but are not published in this report.
NTIS
Montana; Water Quality; Water Resources; Ground Water; Surface Water

20010056668 Geological Survey, Water Resources Div., Tacoma, WA USA
Water, Ice, Meteorological, and Speed Measurements at South Cascade Glacier, Washington, 1999 Balance Year
Krimmel, R. M., Geological Survey, USA; 2000; 48p; In English
Report No.(s): PB2001-104829; USGS/WRI-00-4265; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
Winter snow accumulation and summer snow, firn, and ice melt were measured at South Cascade Glacier, Washington, to determine the winter and net balance for the 1999 balance year. The 1999 winter snow balance, averaged over the glacier, was 3.59 meters, the net balance was 1.02 meters. Since the winter balance record began in 1959, only three winters have had a higher winter balance. Since the net balance record began in 1953, only 2 years have had a greater positive net balance than 1999. Runoff was measured from the glacier and an adjacent non-glacierized basin. Air temperature, precipitation, and humidity were measured nearby, and ice speed was measured. This report makes these data available to the glaciological and climatological community.
NTIS
Glaciers; Hydrology; Ice; Meteorological Parameters; Climatology; Snow Cover; Water; Velocity Measurement; Melting

20010057617 Geological Survey, Water Resources Div., Portland, OR USA

Data-Collection Methods, Quality-Assurance Data, and Site Considerations for Total Dissolved Gas Monitoring, Lower Columbia River, Oregon and Washington, 2000

Tanner, D. Q.; Johnston, M. W.; 2001; 32p; In English

Report No.(s): PB2001-104827; USGS/WRI-01-4005; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Excessive total dissolved gas pressure can cause gas-bubble trauma in fish downstream from dams on the Columbia River. In cooperation with the U.S. Army Corps of Engineers, the U.S. Geological Survey collected data on total dissolved gas pressure, barametric pressure, water temperature, and probe depth at eight stations on the lower Columbia River from the John Day forebay (river mile 215.6) to Camas (river mile 121.7) in water year 2000 (October 1, 1999, to September 30, 2000). These data are in the databases of the U.S. Geological Survey and the U.S. Army Corps of Engineers. Methods of data collection, review, and processing, and quality-assurance data are presented in this report.

NTIS

Dissolved Gases; Gas Analysis; Quality Control; Rivers; Data Acquisition; Data Processing; Gas Pressure

20010057619 Geological Survey, Water Resources Div., New Cumberland, PA USA

Historical Trends and Concentrations of Fecal Coliform Bacteria in the Brandywine Creek Basin, Chester County, Pennsylvania

Town, D. A.; 2000; 58p; In English

Report No.(s): PB2001-105007; USGS/WRIR-01-4026; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

The Brandywine Creek in Chester County is used for recreation and as an important source of drinking water. For this study, 40 sites were established for collection of water samples for analysis of fecal coliform and Escherichia coli bacteria in 1998-99. Samples were collected during base-flow conditions and during five storms in which rainfall exceeded 0.5 inch. During baseflow conditions, the median concentrations of fecal coliform bacteria exceeded 200 col/100 ML at 26 of the 40 sites (65 percent). During stormflow conditions, the median concentration of fecal coliform bacterial exceeded the Pennsylvania Department of Environmental Protection (PaDEP) criterion of 200 col/100 mL at 30 of 33 sites samples (91 percent). Trends in fecal coliform bacteria concentrations were downward for the period 1973-99 at three long-term water-quality monitor stations, the result of upgrades in wastewater treatment plants, decreases in point-source discharge, and a decrease in agricultural land.

NTIS

Bacteria; Water Pollution; Sampling; Water Quality; Pollution Monitoring; Potable Water

20010057620 Geological Survey, Water Resources Div., Idaho Falls, ID USA

Geochemistry of the Big Lost River Drainage Basin, Idaho

Carkeet, C.; Rosentreter, J. J.; Bartholomay, R. C.; Knobel, L. L.; Jan. 2001; 42p; In English

Report No.(s): PB2001-105006; USGS/WRI-01-4031; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

For this study, water samples were collected from 10 wells in the Big Lost River drainage basin during 1999 and analyzed for selected inorganic constitutents, dissolved organic carbon, stable isotopes, tritium, and selected gross measurements of radioactivity. One additional sample was collected as a quality-assurance replicate. Results show that water from the Big Lost River drainage basin has a calcium-magnesium bicarbonate character. The computer code NETPATH was used to evaluate geochemical mass-balance reactions of water with calcite, dolomite, and carbon dioxide gas were considered the dominant reactions. The Arco City well is the farthest downgradient well sampled in the basin, and water from this well can be geochemically modeled from water in upgradient wells.

NTIS

Water Resources; Geochemistry; Idaho; Aquifers; Ground Water; Quality Control; River Basins; Radioactivity; Drainage

20010057621 Geological Survey, Water Resources Div., Coram, NY USA

Hydrogeology and Extent of Saltwater Intrusion of the Great Neck Peninsula, Great Neck, Long Island, New York

Stumm, F., Geological Survey, USA; 2001; 52p; In English

Report No.(s): PB2001-104828; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

Great Neck, a peninsula, in the northwest part of Nassau County, N.Y., is underlain by unconsolidated deposits that form a sequence of aquifers and confining units. Seven public-supply wells have been affected by the intrusion of saltwater from the surrounding embayments (Little Neck Bay, Long Island Sound, Manhasset Bay). Fifteen observation wells were drilled in 1991-96 for the collection of hydrogeologic, geochemical data to delineate the subsurface geology and extent of saltwater

intrusion within the peninsula. Continuous high-resolution seismic-reflection surveys in the embayments surrounding the Great Neck peninsula and the Manhasset Neck peninsula to the east were completed in 1993 and 1994.
NTIS
Hydrogeology; Ground Water; Geochemistry; Data Acquisition; Aquifers; Water Resources

20010057622 Geological Survey, Water Resources Div., Albuquerque, NM USA
Estimates of Mountain-Front Streamflow Available for Potential Recharge to the Tularosa Basin, New Mexico
Waltemeyer, Scott D., Geological Survey, USA; 2001; 20p; In English; Prepared in cooperation with the City of Alamogordo, NM
Report No.(s): PB2001-104824; USGS/WRI-01-4013; No Copyright; Avail: CASI; A01, Microfiche; A03, Hardcopy

Streamflow in the Tularosa Basin, New Mexico, infiltrates into alluvial-basin aquifers at or near mountain fronts. Streamflow at or near mountain fronts is a substantial component of potential recharge to these aquifers. Streamflow response from precipitation differs substantially between the streams draining the Sacramento Mountains on the eastern side of the basin and those draining the San Andres Mountains on the western side.
NTIS
Aquifers; Water Resources; Streams; Ground Water; Mountains; New Mexico

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EARTH RESOURCES AND REMOTE SENSING

Includes remote sensing of earth features, phenomena and resources by aircraft, balloon, rocket, and spacecraft; analysis or remote sensing data and imagery; development of remote sensing products; photogrammetry; and aerial photographs. For instrumentation see 35 Instrumentation and Photography.

20010056603 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA USA
High Resolution Imaging Spectrometer (HIRIS): Science and Instrument
Goetz, Alexander F. H., Colorado Univ., USA; Davis, Curtiss O., Jet Propulsion Lab., California Inst. of Tech., USA; International Journal of Imaging Systems and Technology; 1991; ISSN 0899-9457; Volume 3, pp. 131-143; In English
Contract(s)/Grant(s): JPL-958039; NAS5-30552; Copyright; Avail: Issuing Activity

The High Resolution Imaging Spectrometer (HIRIS) is a facility instrument slated for flight on the second of the EOS-A series of platforms. HIRIS is designed to acquire 24-km wide, 30-m pixel images in 192 spectral bands simultaneously in the 0.4-2.45-micrometer wavelength region. With pointing mirrors it can sample any place on Earth, except the poles, every two days. HIRIS operates at the intermediate scale between the human and the global and therefore links studies of Earth surface processes to global monitoring carried out by lower-resolution instruments. So far, over 50 science data products from HIRIS images have been identified in the fields of atmospheric gases, clouds, snow and ice, water, vegetation, and rocks and soils. The key attribute of imaging spectrometry that makes it possible to derive quantitative information from the data is the large number of contiguous spectral bands. Therefore spectrum matching techniques can be applied. Such techniques are not possible with present-day, multispectral scanner data.
Author
Imaging Spectrometers; Earth Observations (From Space); Data Acquisition

20010056607 Ohio State Univ., Byrd Polar Research Center, Columbus, OH USA
Large-Scale Stabilized Dunes on the High Plains of Colorado : Understanding the Landscape Response to Holocene Climates with the Aid of Images From Space
Forman, Steven L., Ohio State Univ., USA; Goetz, Alexander F. H., Colorado Univ., USA; Yuhas, Roberta H., Colorado Univ., USA; Geology; February 1992; Volume 20, pp. 145-148; In English; Copyright; Avail: Issuing Activity

Principal-component analysis of LANDSAT Thematic Mapper images from eastern Colorado reveals stabilized dune fields that are composed of single and compound parabolic dunes, some longer than 10 km. These dunes have been reactivated at least four times in the past 10000 yr, at ca. 9500 to 5500 yr B.P., 5500 to is greater than 4800 yr B.P., 4800 to is greater than 1000 yr B.P., and is less than 1000 yr B.P., during droughts that probably exceeded the dry conditions during the 1930s. Dune orientations indicate that these landforms were welded by winds from the northwest, which now dominate during the winter and spring with

the passage of Pacific air masses. This study underscores the sensitivity of the landscape of the High Plains to drought conditions, which way become more prevalent because of the on of greenhouse warming.
Author
Dunes; Holocene Epoch; Sensitivity; Terrain; Drought; Paleoclimatology

20010056742 Colorado Univ., Center for the Study of Earth From Space, Boulder, CO USA
Remote Detection and Mapping of Supergene Iron Oxides in the Cripple Creek Mining District, Colorado
Taranik, D. L., Colorado Univ., USA; Kruse, F. A., Colorado Univ., USA; Goetz, A. F. H., Colorado Univ., USA; Atkinson, W. W., Colorado Univ., USA; [1990]; ISSN 0000-0170, pp. 1707-1709; In English
Contract(s)/Grant(s): NAGW-1143; Copyright; Avail: Issuing Activity

The Geophysical and Environmental Research Imaging Spectrometer (GERIS) was flown over the Cripple Creek mining district in south-central Colorado to improve the geological understanding of the district. As part of the study, an airborne mapping technique was developed for the discrimination of the ferric iron minerals hematite, goethite, and jarosite, minerals often important indicators of the distribution of economic mineralization. A software technique was developed which uses the binary encoding of spectral slopes to identify the mineral hematite from the group goethite/jarosite. Mixtures of hematite and goethite can also be detected with GERIS data. The study included district-wide field mapping and spectral measurements to evaluate the accuracy of the image classifications. The ARC/INFO geographic information system (GIS) was a useful tool which allowed quantitative comparison of the field mapping and GERIS image data sets. The study results demonstrate the ability to discriminate individual iron minerals using imaging spectroscopy, and the development of a rapid mapping technique useful in the reconnaissance stage of minerals exploration.
Author
Remote Sensing; Imaging Spectrometers; Minerals; Iron Oxides; Thematic Mapping

20010056938 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA USA
Coherent Effects in Microwave Backscattering Models for Forrest Canopies
Saatchi, Sasan S., Jet Propulsion Lab., California Inst. of Tech., USA; McDonald, Kyle C., Jet Propulsion Lab., California Inst. of Tech., USA; IEEE Transactions on Geoscience and Remote Sensing; July 1997; ISSN 0196-2892; Volume 35, No. 4, pp. 1032-1044; In English; Copyright; Avail: Issuing Activity

In modeling forest canopies, several scattering mechanisms are taken into account: (1) volume scattering; (2) surface-volume interaction; and (3) surface scattering from forest floor. Depending on the structural and dielectric characteristics of forest canopies, the relative contribution of each mechanism in the total backscatter signal of an imaging radar can vary. In this paper, two commonly used first-order discrete scattering models, distorted born approximation (DBA) and radiative transfer (RT) are used to simulate the backscattered power received by polarimetric radars at P-, L-, and C-bands over coniferous and deciduous forests. The difference between the two models resides on the coherent effect in the surface-volume interaction terms. to demonstrate this point, the models are first compared based on their underlying theoretical assumptions and then according to simulation results over coniferous and deciduous forests. It is shown that by using the same scattering functions for various components of trees (i.e., leaf, branch, stem), the radiative transfer and distorted Born models are equivalent, except in low frequencies, where surface-volume interaction terms may become important, and the coherent contribution may be significant. In this case, the difference between the two models can reach up to 3 dB in both co-polarized and cross-polarized channels, which can influence the performance of retrieval algorithms.
Author
Backscattering; Canopies (Vegetation); Forests; Microwaves; Scattering Functions

20010056940 Colorado Univ., Center for the Study of Earth from Space, Boulder, CO USA
Vegetation Biochemistry: What Can Imaging Spectrometry Tell Us About Canopies?
Goetz, Alexander F. H., Colorado Univ., USA; Gao, Bo-Cai, Colorado Univ., USA; Wessman, Carol, Colorado Univ., USA; 6th Australasian Remote Sensing Conference; [1991], pp. 3-50 - 3-58; In English; 6th Austalasian Remote Sensing Conference, Wellington, New Zealand
Contract(s)/Grant(s): NAS5-31711; NAS5-31715; Copyright; Avail: Issuing Activity

Changes in ecosystem processes such as productivity and decomposition may be expressed in the canopy foliar chemistry resulting from altered carbon allocation patterns, metabolic processes and nutrient availability. Understanding carbon balance on land over large regions requires quantitative determination of leaf constituents such as lignin and total nitrogen from remote sensing imaging systems. Results from spectral reflectance measurements of stacked leaves in the laboratory show that spectrum matching techniques are applicable to the derivation of the equivalent liquid water thickness in plants as well as to the extraction

of dry leaf matter reflectance spectra from spectra of green leaves. The residual spectra derived by subtracting water spectra from the spectra of green leaves shows a feature at 1.72 micrometers that can be related to the lignin content of the leaves. Oak leaves have a deeper residual absorption feature than do cotton leaves which is consistent with their relative lignin content. Similar results are achieved when deriving the residuals from images taken over areas of grass and pine trees. Imaging spectrometry provides promise in developing images of various foliar biochemical constituents.
Author
Biochemistry; Imaging Spectrometers; Canopies (Vegetation); Leaves; Spectra

20010059188 Los Alamos National Lab., NM USA
Performance of the MTI Dense-Cloud Mask Algorithm, and Its Refinement with a Genetic Learning Program
Lewis Hirsch, K.; Brumby, S. P.; Harvey, N. R.; Davis, A. B.; Oct. 26, 2000; 16p; In English; SPIE International Symposium on Optical Science and Technology, 30 Jul. - Aug. 2000, San Diego, CA, USA; Sponsored by International Society for Optical Engineering, USA
Report No.(s): PB2001-105676; LA-UR-00-2964; No Copyright; Avail: National Technical Information Service (NTIS)

In support of its dual mission in environmental studies and nuclear nonproliferation, the Multispectral Thermal Irnager (MTI) has enhanced spatial and radiometric resolutions and state-of-the-art calibration capabilities. These instrumental developments put a new burden on retrieval algorithm developers to pass this accuracy onto the inferred geophysical parameters. In particular, current atmospheric correction schemes assume the intervening atmosphere is adequately modeled as a plane parallel horizontally homogeneous medium. A single dense-enough cloud in view of the ground target can easily offset reality from the calculations, hence the need for a reliable cloud masking algorithm. The authors have created a cloud mask using simple, user defined thresholds. This mask compares quite favorably to the MODIS cloud mask. While it does require user intervention, it does not require large amounts of processing time or disk space. They have also compared the results to an evolved solution for masking clouds. Again, the simple method compares favorably to the genetic algorithm derived mask.
NTIS
Genetic Algorithms; Imaging Spectrometers; Multispectral Photography

44
ENERGY PRODUCTION AND CONVERSION

Includes specific energy conversion systems, e.g., fuel cells; and solar, geothermal, windpower, and waterwave conversion systems; energy storage; and traditional power generators. For technologies related to nuclear energy production see 73 Nuclear Physics. For related information see also 07 Aircraft Propulsion and Power; 20 Spacecraft Propulsion and Power, and 28 Propellants and Fuels.

20010056310 Auburn Univ., Space Power Inst., AL USA
Hypervelocity Impact Studies on Solar Cell Modules ***Final Report, 17 Sep. 1999 - 31 Oct. 2000***
Brandhorst, Henry W., Jr., Auburn Univ., USA; Best, Stevie R., Auburn Univ., USA; Mar. 25, 2001; 6p; In English; Original contains color illustrations
Contract(s)/Grant(s): NAS3-99200
Report No.(s): AU-4-21839; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Space environmental effects have caused severe problems as satellites move toward increased power and operating voltage levels. The greatest unknown, however, is the effect of high velocity micrometeoroid impacts on high voltage arrays (>200V). Understanding such impact phenomena is necessary for the design of future reliable, high voltage solar arrays, especially for Space Solar Power applications. Therefore, the objective of this work was to study the effect of hypervelocity impacts on high voltage solar arrays. Initially, state of the art, 18% efficient GaAs solar cell strings were targeted. The maximum bias voltage on a two-cell string was -200 V while the adjacent string was held at -140 V relative to the plasma potential. A hollow cathode device provided the plasma. Soda lime glass particles 40-120 micrometers in diameter were accelerated in the Hypervelocity Impact Facility to velocities as high as 11.6 km/sec. Coordinates and velocity were obtained for each of the approximately 40 particle impact sites on each shot. Arcing did occur, and both discharging and recharging of arcs between the two strings was observed. The recharging phenomena appeared to stop at approximately 66V string differential. No arcing was observed at 400 V on concentrator cell modules for the Stretched Lens Array.
Author
Hypervelocity Impact; Solar Arrays; Arc Discharges

20010056905 Illinois Inst. of Tech., Chicago, IL USA

Minority Institution ARO Fuel Cell/Battery Manufacturing Research Hub ***Final Report, 22 Aug. 1994-31 Aug. 2000***

Selman, J. R., Illinois Inst. of Tech., USA; Feb. 22, 2001; 15p; In English

Contract(s)/Grant(s): DAAH04-94-G-0055

Report No.(s): AD-A388528; ARO-32633.6-CH-HUB; No Copyright; Avail: CASI; A01, Microfiche; A03, Hardcopy

The Minority Institution ARO Fuel Cell/Battery/Manufacturing Hub at IIT (”Hub”) focused during its six-year activity on three tasks. Task 1 concerned fuel cell and fuel cell manufacturing research, specifically concentrated on the direct methanol fuel cell (DMFC); (2) high-energy rechargeable battery research concentrated on Li-ion batteries; (3) minority outreach to give undergraduate minority students hands-on experience in electrochemical energy conversion technology and attract them to graduate studies. IIT acted as the lead institution for a consortium including five major research universities, a national lab, and two small companies, as well as three minority institution universities. The research function produced five patent or patent applications and more than 25 articles in refereed journals. These papers report results in DMFC performance, fuel cell and electro-organic electrocatalysis, combinatorial methods for catalyst discovery, molecular modeling of electrocatalytic mechanisms, synthesis of novel lithium-battery materials, and thermal characterization of Li-ion batteries. A specially structured minority outreach program gave 40 students hands-on experience, of which nine continued to graduate studies.

DTIC

Fuel Cells; Manufacturing; Electric Batteries; Students; Minorities; Electrocatalysts; Catalysts

20010058583 National Renewable Energy Lab., Golden, CO USA

Fast AD Code Verification: A Comparison to ADAMS

Buhl, M. L.; Wright, A. D.; Price, K. G.; Feb. 2001; 18p; In English; 20th; American Society of Mechanical Engineers (ASME) Wind Energy Symposium, 8-11 Jan. 2001, Reno, NV, USA; Sponsored by American Society of Mechanical Engineers, USA

Report No.(s): PB2001-105587; NREL/CP-500-28848; No Copyright; Avail: National Technical Information Service (NTIS)

The National Renewable Energy Laboratory’s National Wind Technology Center (NWTC) had refocused its wind-turbine design-code comparison effort to verify FAST-AD with ADAMS. FAST-AD is a wind-turbine structural-response code developed by Oregon State University for the NWTC. ADAMS is a commercial, general-purpose, multibody-dynamics code developed by mechanical Dynamics, Inc. ADAMS, which is used in many industries, has been rigorously tested. Both ADAMS and FAST-AD use the AeroDyn subroutine package for calculating aerodynamics forces. The University of Utah developed AeroDyn for the NWTC. to compare FAST-AD to ADAMS, we modeled a rough approximation of the AWT-27 P4 turbine, using the same properties for both simulators. The AWT-27 is a 275-kilowatt(kw), two-bladed wind turbine. We also created three-bladed versions of the turbine models to verify FAST-AD for three-bladed turbines. In this paper, we list the aerodynamic features used in the comparison. We also explain how the programs model the turbine structure, describe the degrees of freedom (DOFs) used for this study, and present simulation comparisons that show very good agreement.

NTIS

Energy Technology; Renewable Energy; Wind Turbines

20010059037 NASA Glenn Research Center, Cleveland, OH USA

Status of Photovoltaic Calibration and Measurement Standards

Baraona, Cosmo, NASA Glenn Research Center, USA; Bailey, Sheila, NASA Glenn Research Center, USA; Curtis, Henry, NASA Glenn Research Center, USA; Brinker, David, NASA Glenn Research Center, USA; Jenkins, Phillip, Ohio Aerospace Inst., USA; Scheiman, David, Ohio Aerospace Inst., USA; [2001]; 2p; In English; 36th Intersociety Energy Conversion Conference, 29 Jul. - 2 Aug. 2001, Savannah, GA, USA; Sponsored by American Society of Mechanical Engineers, USA

Contract(s)/Grant(s): RTOP 755-A4-03; Copyright; Avail: Issuing Activity

The 7th International Workshop on Space Solar Cell Calibration and Measurement was held on September 25-27, 2000 in Girdwood, Alaska. Representatives from eight countries discussed international standards for single and multijunction solar cell measurement and calibration methods, round robin intercomparisons, and irradiation test methods for space solar cells. Progress toward adoption of an ISO standard on single junction cells was made. Agreement was reached to begin work on new standards for multijunction cells and irradiation testing. Progress on present single junction round robin measurements was discussed and future multijunction round robins were planned. The next workshop will be held in Germany in October 2001.

Author

Standards; Solar Cells; Conferences

20010059329 Corps of Engineers, Engineer Research and Development Center, Champaign, IL USA
Site Evaluation for Application of Fuel Cell Technology, Construction Battalion Center, Port Hueneme, CA ***Final Report***
Binder, Michael J., Corps of Engineers, USA; Holcomb, Franklin H., Corps of Engineers, USA; Taylor, William R., Corps of Engineers, USA; Feb. 2001; 27p; In English
Contract(s)/Grant(s): DACA88-94-D-0020
Report No.(s): AD-A388670; ERDC/CERL-TR-01-16; No Copyright; Avail: CASI; A01, Microfiche; A03, Hardcopy

Fuel cells are an environmentally clean, quiet, and a highly efficient method for generating electricity and heat from natural gas and other fuels. Researchers at the U.S. Army Engineer Research and Development Center (ERDC), Construction Engineering Research Laboratory (CERL) have actively participated in the development and application of advanced fuel cell technology since fiscal year 1993 (FY93). CERL selected and evaluated application sites, supervised the design and installation of fuel cells, actively monitored this operation and maintenance of fuel cells, and compiled ”lessons learned” for feedback to manufacturers for 29 of 30 commercially available fuel cell power plants and their thermal interfaces installed at Department of Defense (DoD) locations. This report presents an overview of the information collected at Port Hueneme, CA, along with a conceptual fuel cell installation layout and description of potential benefits the technology can provide at that location. Similar summaries of the site evaluation surveys for the remaining 28 sites where CERL has managed and continues to monitor fuel cell installation and operation are available in the companion volumes to this report.
DTIC
Fuel Cells; Energy Conservation; Natural Gas; Fuel Cell Power Plants

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ENVIRONMENT POLLUTION

Includes atmospheric, water, soil, noise, and thermal pollution.

20010055271 NASA Kennedy Space Center, Cocoa Beach, FL USA
Reactive Material Placement Technique for Groundwater Treatment
Quinn, Jacqueline W., Inventor, NASA Kennedy Space Center, USA; Clausen, Christian A., Inventor, NASA Kennedy Space Center, USA; Reinhart, Debra R., Inventor, NASA Kennedy Space Center, USA; Chopra, Manoj B., Inventor, NASA Kennedy Space Center, USA; Mar. 27, 2001; 10p; In English; Continuation-in-part of US-Patent-Appl-SN-904028, filed 31 Aug. 1997 which is a provisional application of US-Patent-Appl-SN-060494, filed 30 Sep. 1997
Patent Info.: Filed 13 Jul. 1998; NASA-Case-KSC-11957; US-Patent-6,207,114; US-Patent-Appl-SN-127860; US-Patent-Appl-SN-904028; US-Patent-Appl-SN-060494; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The invention provides a permeable treatment wall comprising one or more high-permeability columns, as well as a methods for preparing such a permeable treatment wall.
Official Gazette of the U.S. Patent and Trademark Office
Water Treatment; Walls; Permeability

20010056292 NASA Goddard Space Flight Center, Greenbelt, MD USA
Tropospheric Ozone Pollution Transport Traced from the TOMS (Total Ozone Mapping Spectrometer) Instrument During the Nashville-1999 Campaign
Thompson, Anne M., NASA Goddard Space Flight Center, USA; Frolov, A. D., Maryland Univ., USA; Hudson, R. D., Maryland Univ., USA; Witte, J. C., EITI, USA; [2000]; 1p; In English; American Geophysical Union Fall Meeting, 15-19 Dec. 2000, San Francisco, CA, USA; Sponsored by American Geophysical Union, USA; No Copyright; Avail: Issuing Activity; Abstract Only

Over the past several years, we have developed two new tropospheric ozone retrievals from the TOMS (Total Ozone Mapping Spectrometer) satellite instrument that are of sufficient resolution to follow pollution episodes. The modified-residual technique [Hudson and Thompson, 1998; Thompson and Hudson, 1999] uses v. 7 TOMS total ozone and is applicable to tropical regimes in which the wave-one pattern in total ozone is observed. The TOMS-direct method [(”TDOT” = TOMS Direct Ozone in the Troposphere; Frolov et al., 2000] represents a new algorithm that uses TOMS radiances directly (i.e., not previously processed for TOMS ozone) to extract tropospheric ozone in regions of constant stratospheric ozone and tropospheric ozone displaying high mixing ratios and variability characteristic of pollution. These events tend to occur in certain meteorological regimes. For example, mid-latitude pollution usually occurs on the backside of subtropical fronts, as low pv, usually moist air intrudes to the extra-tropics. July 1999 was a month characterized by robust pollution in the eastern US, with high ozone, as detected by TOMS, originating over south central states and moving up the Atlantic seaboard. This corresponds to 50-80 DU in tropospheric ozone column depth. In most cases, further transport occurred to the North Atlantic, with ozone plumes traveling to western Europe in

4-5 days. Examples of high ozone and transit across boundaries within the US, as well as US->Europe, give a regional context for model results and field measurements taken in the SE US during the Nashville-1999 campaign period. Validation of the TDOT maps is made with ozonesondes taken during that time. TDOT maps also show ozone pollution from Asia traveling to the western US in July 1999.
Author
Total Ozone Mapping Spectrometer; Atmospheric Composition; Ozone; Pollution Transport; Air Pollution; Troposphere

20010056296 NASA Goddard Space Flight Center, Greenbelt, MD USA
Strategy to use the Terra Aerosol Information to Derive the Global Aerosol Radiative Forcing of Climate
Kaufman, Yoram J., NASA Goddard Space Flight Center, USA; Tanre, Didier, Lille-1 Univ., France; [2000]; 1p; In English; American Geophysical Union Fall Meeting, 15-19 Dec. 2000, San Francisco, CA, USA; Sponsored by American Geophysical Union, USA; No Copyright; Avail: Issuing Activity; Abstract Only

Terra will derive the aerosol optical thickness and properties. The aerosol properties can be used to distinguish between natural and human-made aerosol. In the polar orbit Terra will measure aerosol only once a day, around 10:30 am. How will we use this information to study the global radiative impacts of aerosol on climate? We shall present a strategy to address this problem. It includes the following steps: - From the Terra aerosol optical thickness and size distribution model we derive the effect of aerosol on reflection of solar radiation at the top of the atmosphere. In a sensitivity study we show that the effect of aerosol on solar fluxes can be derived 10 times more accurately from the MODIS data than derivation of the optical thickness itself. Applications to data over several regions will be given. - Using 1/2 million AERONET global data of aerosol spectral optical thickness we show that the aerosol optical thickness and properties during the Terra 10:30 pass are equivalent to the daily average. Due to the aerosol lifetime of several days measurements at this time of the day are enough to assess the daily impact of aerosol on radiation. - Aerosol impact on the top of the atmosphere is only part of the climate question. The INDOEX experiment showed that addressing the impact of aerosol on climate, requires also measurements of the aerosol forcing at the surface. This can be done by a combination of measurements of MODIS and AERONET data.
Author
Climate; Aerosols; Optical Thickness; Size Distribution; Imaging Spectrometers

20010056303 NASA Goddard Space Flight Center, Greenbelt, MD USA
Satellite and Ground-based Radiometers Reveal Much Lower Dust Absorption of Sunlight than Used in Climate Models
Kaufman, Y. J., NASA Goddard Space Flight Center, USA; Tanre, D., Lille-1 Univ., France; Dubovik, O., Science Systems and Applications, Inc., USA; Karnieli, A., Ben Gurion Univ. of the Negev, Israel; Remer, L. A., NASA Goddard Space Flight Center, USA; [2000[; 1p; In English; American Geophysical Union Fall Meeting, 15-19 Dec. 2000, San Francisco, CA, USA; Sponsored by American Geophysical Union, USA; No Copyright; Avail: Issuing Activity; Abstract Only

The ability of dust to absorb solar radiation and heat the atmosphere is one of the main uncertainties in climate modeling and the prediction of climate change. Dust absorption is not well known due to limitations of in situ measurements. New techniques to measure dust absorption are needed in order to assess the impact of dust on climate. Here we report two new independent remote sensing techniques that provide sensitive measurements of dust absorption. Both are based on remote sensing. One uses satellite spectral measurements, the second uses ground based sky measurements from the AERONET network. Both techniques demonstrate that Saharan dust absorption of solar radiation is several times smaller than the current international standards. Dust cooling of the earth system in the solar spectrum is therefore significantly stronger than recent calculations indicate. We shall also address the issue of the effects of dust non-sphericity on the aerosol optical properties.
Author
Sunlight; Dust; Solar Radiation; Radiation Absorption; Aerosols

20010056406 Earth Technology, Concord, MA USA
Determination of the Horizontal Diffusion Coefficient for Use in the Sarmap Air Quality Model ***Final Report***
Yamartino, R. Y.; Fernau, M. E.; May 2000; 88p; In English
Contract(s)/Grant(s): ARB-96-314
Report No.(s): PB2001-104855; No Copyright; Avail: CASI; A01, Microfiche; A05, Hardcopy

The California Air Resources Board (ARB) Request for Proposals (RFP), entitled Determination of the Horizontal Diffusion Coefficient for Use in Air Quality Model (SAQM) and called for the theoretical formulation, experimental quantification, and within-SAQM sensitivity testing of diffusivity formulations that will yield net levels of pollutant dispersion that accurately mimic reality. Such a diffusivity formulation must account for the dominant atmospheric advective (e.g., wind shear) and turbulent

transfer processes, compensate for smoothing or filtering present in the modeled wind fields, and correct for the unintended mixing processes accompanying present-day numerical advection schemes.
NTIS
Air Quality; Contaminants; Diffusion Coefficient; Atmospheric Diffusion; Air Pollution; Environmental Monitoring

20010056407 California Inst. of Tech., Pasadena, CA USA
Aircraft Sampling to Determine Atmospheric Concentrations and Size Distributions of Particulate Matter and Other Pollutants Over the South Coast Air Basin *Final Report*
Seinfeld, J. H.; Collins, D. R.; Jonsson, H. H.; Liao, H.; Flagan, R. C.; May 2000; 76p; In English
Contract(s)/Grant(s): ARB-96-315
Report No.(s): PB2001-104856; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

As part of the 1997 Southern California Ozone Study-North American Research Strategy for Tropospheric Ozone (SCOS97-NARSTO), a research aircraft was employed during August and September of 1997 to characterize the physical and chemical properties of the aerosol present over the Los Angeles Basin. Aerosol size distributions measured using a differential mobility analyzer and two optical particulate counters were combined with filter based composition measurements to derive a physicochemical description of the aerosol sampled. The accuracy of this description was evaluated through comparison of derived and directly measured aerosol properties including mass, absorption coefficient, hemispherical backscattering coefficient, and total scattering coefficient at two different relative humidities. The sampled aerosol exhibited a complex vertical structure possessing multiple elevated aerosol layers. The most pronounced of these layers were observed to form by injection of aerosol above the ground-level mixed layer along the southern edge of the San Gabriel Mountains.
NTIS
Atmospheric Composition; Atmospheric Sounding; Contaminants; Particulates; Aerosols

20010056663 Geological Survey, Water Resources Div., Indianapolis, IN USA
Use of Borehole and Surface Geophysics to Investigate Ground-Water Quality near a Road-Deicing Salt-Storage Facility, Valparaiso, Indiana
Risch, M. R.; Robinson, B. A.; 2001; 76p; In English
Report No.(s): PB2001-105349; USGS/WRIR-00-4070; No Copyright; Avail: CASI; A01, Microfiche; A05, Hardcopy

Borehole and surface geophysics were used to investigate ground-water quality affected by a road-deicing salt-storage facility located near a public water-supply well field. From 1994 through 1998, borehole geophysical logs were made in an existing network of monitoring wells completed near the bottom of a thick sand aquifer. Logs of natural gamma activity indicated a uniform and negligible contribution of clay to the electromagentic conductivity of the aquifer so that the logs of electromagentic conductivity primarily measured the amount of dissolved solids in the ground water near the wells.
NTIS
Boreholes; Water Quality; Geophysics; Water Pollution; Hydrogeology; Pollution Monitoring

20010056666 California Univ., San Francisco, CA USA
Pulmonary Macrophage Release of Inflammatory Cytokines After Multi-Day Nitric Acid Vapor and Ozone Exposure *Final Report*
Blanc, P., California Univ., USA; Sep. 14, 2000; 54p; In English
Contract(s)/Grant(s): ARB-93-331
Report No.(s): PB2001-104853; No Copyright; Avail: CASI; A01, Microfiche; A04, Hardcopy

This study measured ex-vivo production of pro-inflammatory cytokines by pulmonary macrophages. The macrophages were isolated from bronchoalveolar lavage fluid (BALF) obtained from human subjects who had under gone controlled exposures to ozone (O3), nitric acid (HNO3), or both together. The study was based on the premise that pulmonary macrophages are activated by exposure to O3 and HNO3 vapor, and that they will continue to secrete cytokines after removal from BALF. The cytokines of interest included tumor necrosis factor-alpha (TNF-alpha), interleukin-1-beta (IL-1-beta), interleukin-6 (IL-6), interleukin-8 (IL-8), and macrophage inflammatory protein-1-alpha (MIP-1-alpha). Cells from BALF were suspended in culture medium, and were plated in microwells.
NTIS
Culture Techniques; Macrophages; Air Pollution; Exposure; Respiratory Diseases; Respiration; Human Beings; Proteins; Tumors

20010056667 California Univ., Air Pollution Health Effects Lab., Irvine, CA USA

Effects of Multiple Day Exposure to Nitrogen Dioxide on Human Cellular Immunity: Human Macrophage Responses ***Final Report***

Kleinman, Michael T., California Univ., USA; Balmes, John, California Univ., USA; Solomon, Colin, California Univ., USA; Jul. 10, 1998; 40p; In English

Report No.(s): PB2001-104852; ARB-R-95/311; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Fifteen healthy volunteers were recruited, provided informed consent and were characterized with respect to pulmonary function, airway resistance and non-specific airway reactivity. The subjects were exposed to filtered air (FA) or 2.0 ppm nitrogen dioxide (NO2) for 4-hr per day, alternating 30-minute periods of rest and exercise, for 3 consecutive days. Bronchoscopy and bronchoalveolar lavage were performed 18-hr after the 3rd day of either FA or NO2 exposure. Macrophages were recovered from the bronchoalveolar lavage fluid and selected macrophage functions were assayed. Assays were performed for superoxide free radical production by the macrophages before and after stimulation with phorbol myristate acetate (PMA) and before and after simulation with serum-incubated yeast particles (opsonized zymosan). This function, known as respiratory burst activity, is an important part of lung defenses against infectious agents. However, excessive free radical production can overwhelm tissue defenses and cause injury.

NTIS

Nitrogen Dioxide; Pulmonary Functions; Exposure; Infectious Diseases; Macrophages; Air Pollution; Immune Systems; Assaying

20010056685 Colorado State Univ., Cooperative Inst. for Research in the Atmosphere, Fort Collins, CO USA

A Study of the Role of Clouds in the Relationship Between Land Use/Land Cover and the Climate and Air Quality of the Atlanta Area ***Final Report, 1 Sep. 1997 - 20 May 2001***

Kidder, Stanley Q., Colorado State Univ., USA; Hafner, Jan, Colorado State Univ., USA; May 2001; 79p; In English; Original contains color illustrations

Contract(s)/Grant(s): NAS8-97082; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

The goal of Project ATLANTA is to derive a better scientific understanding of how land cover changes associated with urbanization affect climate and air quality. In this project the role that clouds play in this relationship was studied. Through GOES satellite observations and RAMS modeling of the Atlanta area, we found that in Atlanta (1) clouds are more frequent than in the surrounding rural areas; (2) clouds cool the surface by shading and thus tend to counteract the warming effect of urbanization; (3) clouds reflect sunlight, which might other wise be used to produce ozone; and (4) clouds decrease biogenic emission of ozone precursors, and they probably decrease ozone concentration. We also found that mesoscale modeling of clouds, especially of small, summertime clouds, needs to be improved and that coupled mesoscale and air quality models are needed to completely understand the mediating role that clouds play in the relationship between land use/land cover change and the climate and air quality of Atlanta. It is strongly recommended that more cities be studied to strengthen and extend these results.

Author

Clouds (Meteorology); Gas Composition; Satellite Observation; Mesoscale Phenomena; Ozone; Air Quality; Land Use

20010056846 Environmental Protection Agency, Office of Pollution, Prevention, and Toxics, Washington, DC USA

Laboratory Accreditation Program Guidelines: Measurement of Lead in Paint, Dust, and Soil ***Final Report***

Mar. 1992; 30p; In English

Report No.(s): PB2001-105345; EPA/747/R-92/001; No Copyright; Avail: CASI; A01, Microfiche; A03, Hardcopy

This report summarizes the results of meetings that were held to discuss guidelines and recommendations for conducting an intergovernmental agency laboratory accreditation program (LAP) for the chemical analysis of lead in paint, dust, and soil. The main factors to consider in establishing a LAP are the administrative structure, quality assurance policy, performance evaluation materials, method protocols, site inspections, and administrative rules. This report suggests guidelines for structuring a LAP for lead in paint, dust, and soil. It is recommended that existing programs be utilized as much as possible, but uniformity of requirements between the programs is needed. This can be accomplished by establishing an organization that monitors and coordinates the activities of the laboratory accreditors. The development of uniform requirements will create the potential for reciprocity between accrediting organizations for the LAP. The implementing agency will have to establish from already existing models, concepts of quality assurance to be expected from the accredited laboratories.

NTIS

Lead (Metal); Paints; Dust; Soils; Chemical Analysis; Quality Control

20010056903 NASA Goddard Space Flight Center, Greenbelt, MD USA

Global Warming in the Twenty-First Century: An Alternative Scenario

Hansen, James, NASA Goddard Space Flight Center, USA; Sato, Makiko, NASA Goddard Space Flight Center, USA; Ruedy, Reto, NASA Goddard Space Flight Center, USA; Lacis, Andrew, NASA Goddard Space Flight Center, USA; Oinas, Valdar, NASA Goddard Space Flight Center, USA; Geophysics; Aug. 29, 2000; Volume 97, No. 18, pp. 9875-9880; In English; RAG Coal International Meeting, 30 Mar. 2001, Herndon, VA, USA; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

A common view is that the current global warming rate will continue or accelerate. But we argue that rapid warming in recent decades has been driven mainly by non-CO2 greenhouse gases (GHGs), such as chlorofluorocarbons, CH4, and N2O, not by the products of fossil fuel burning, CO2 and aerosols, the positive and negative climate forcings of which are partially offsetting. The growth rate of non-CO2 GHGs has declined in the past decade. If sources of CH4 and O3 precursors were reduced in the future, the change in climate forcing by non-CO2 GHGs in the next 50 years could be near zero. Combined with a reduction of black carbon emissions and plausible success in slowing CO2 emissions, this reduction of non-CO2 GHGs could lead to a decline in the rate of global warming, reducing the danger of dramatic climate change. Such a focus on air pollution has practical benefits that unite the interests of developed and developing countries. However, assessment of ongoing and future climate change requires composition specific long-term global monitoring of aerosol properties.

Author

Global Warming; Climate Change; Greenhouse Effect

20010056930 Environmental Protection Agency, Office of Policy, Planning and Evaluation, Washington, DC USA

States Guidance Document: Policy Planning to Reduce Greenhouse Gas Emissions, Second Edition

May 1998; 234p; In English; Original contains color illustrations

Report No.(s): PB2001-105276; No Copyright; Avail: National Technical Information Service (NTIS)

State-level policies to control greenhouse gas emissions are essential for mitigating the economic, health, and environmental threats posed by global climate change. States play a crucial role in helping the US as a whole to meet the national pledge to reduce greenhouse gas emissions. However, the circumstances surrounding climate change creates a complicated and politically volatile situation for policy-makers who must deal with complex and uncertain scientific issues and develop policies that potentially affect multiple economic sectors, including energy, transportation, agriculture, industry, and forestry. This guidance document is intended to help states evaluate these complex issue and develop response strategies that address their distinct situations. EPA's objective is to assist each state in formulating a realistic State Action Plan for addressing greenhouse gas emissions. This document represents the second phase in EPA's State and Local Outreach Program. The first phase produced the State Workbook: Methodologies for Estimating Greenhouse Gas Emissions, which contains a set of guidelines and methodologies for states to use to compile an inventory of their greenhouse gas emissions and sinks. Identifying emission sources and sinks and compiling an inventory is a critical first step in building a comprehensive and long range state action plan. The State Workbook is available through EPA's Office of Policy, Planning and Evaluation, Office of Economy and Environment.

NTIS

Exhaust Emission; Greenhouse Effect; Climatology; Policies

20010056932 Environmental Protection Agency, Office of the Administrator, Washington, DC USA

Aiming for Excellence: Actions to Encourage Stewardship and Accelerate Environmental Progress

Jul. 1999; 72p; In English; Original contains color illustrations

Report No.(s): PB2001-105298; EPA/100/R-99/006; No Copyright; Avail: National Technical Information Service (NTIS)

At the U.S. Environmental Protection Agency (EPA), that challenge led us to rethink how we go about achieving environmental and public health protection goals. In March 1995, we launched a small set of high-priority projects that quickly evolved into a broader reinvention agenda for the Agency. Today, we have numerous reinvention efforts under way. Many focus on improving well-established programs, such as permitting and compliance assurance. The emphasis is on streamlining regulatory processes and introducing innovations that can make these programs more efficient and effective. Others focus on finding fundamentally new approaches for the future. Our reinvention initiatives are designed to address environmental problems that have yet to be solved through the current system.

NTIS

Environment Protection; Regulations

20010057606 Sonoma Technology, Inc., Petaluma, CA USA

User's Guide for the Breton Offshore Activities Data System (BOADS) for Air Quality ***Final Report***

Coe, D. L.; Ladner, D. J.; Prouty, J. D.; Chinkin, L. R.; Yocke, M.; Feb. 2001; 76p; In English; Original contains color illustrations

Contract(s)/Grant(s): MMS-1435-01-98-CT-30856

Report No.(s): PB2001-105446; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

The Minerals Management Service (MMS) mandated that offshore operators in the Gulf of Mexico participate in a monthly survey program for the year 2000, during which time the MMS will collect information regarding offshore operations (see Notice to Lessees No. 99-G14). The purpose of these surveys is to assist the MMS in constructing an emission inventory for the Gulf of Mexico near the Breton National Wilderness Area. The MMS funded the development of the Breton Offshore Activities Data System (BOADS) software in order to assist offshore operators in complying with the MMS mandate. BOADS assists users in recording information regarding emissions-related offshore activities and generates computer data files that can be delivered to the MMS. This document is a user guide to the BOADS software.

NTIS

Air Quality; Data Systems; Air Pollution; Computer Programs; Offshore Energy Sources; Drilling; User Manuals (Computer Programs)

20010057612 California Univ., Lawrence Berkeley Lab., Environmental Energy Technologies Div., Berkeley, CA USA

Guidelines for the Monitoring, Evaluation, Reporting, Verification, and Certification of Forestry Projects for Climate Change Mitigation

Vine, E.; Sathaye, J.; Makundi, W.; Mar. 1999; 128p; In English

Report No.(s): PB2001-105274; LBNL-41877; No Copyright; Avail: National Technical Information Service (NTIS)

To combat the growing threat of global climate change from increasing concentrations of greenhouse gases in the atmosphere, the Kyoto Protocol includes project-based mitigation efforts to achieve large-scale and cost-effective emissions reductions. The Protocol requires real and measurable reductions in emissions that are additional to any that would occur in the absence of a certified project activity. Monitoring, evaluation, reporting, verification and certification of these projects are activities that the U.S. Environmental Protection Agency (EPA) sees as important. EPA has initiated a three-phase process in developing usable guidelines on monitoring, evaluation, reporting, verification and certification (MERVC). In the first phase, an overview of MERVC issues was prepared by E. Vine and J. Sathaye, 1997. The Monitoring, Evaluation, Reporting, and Verification of Climate Change Mitigation Projects: Discussion of Issues and Methodologies and Review of Existing Protocols and Guidelines.

NTIS

Certification; Climate Change; Environment Protection; Forest Management; Climatology; Forests

20010057613 California Univ., Lawrence Berkeley Lab., Environmental Energy Technologies Div., Berkeley, CA USA

Guidelines for the Monitoring, Evaluation, Reporting, Verification, and Certification of Energy-Efficiency Projects for Climate Change Mitigation

Vine, E.; Sathaye, J.; Mar. 1999; 148p; In English

Report No.(s): PB2001-105269; LBNL-41543; No Copyright; Avail: National Technical Information Service (NTIS)

Because of concerns with the growing threat of global climate change from increasing concentrations of greenhouse gases in the atmosphere, the United States and other countries are implementing, by themselves or in cooperation with one or more other nations, climate change mitigation projects. These projects will reduce greenhouse gas (GHG) emissions, and may also result in non-GHG benefits and costs (i.e., other environmental and socioeconomic benefits and costs). Monitoring, evaluating, reporting, verifying, and certifying (MERVC) guidelines are needed for these projects in order to accurately determine their impact on GHG and other attributes. Implementation of standardized guidelines is also intended to: (1) increase the reliability of data for estimating GHG benefits; (2) provide real-time data so that programs and plans can be revised mid-course; (3) introduce consistency and transparency across project types and reporters; (4) enhance the credibility of the projects with stakeholders; (5) reduce costs by providing an international, industry consensus approach and methodologies; and (6) reduce financing costs, allowing project bundling and pooled project financing.

NTIS

Climate Change; Energy Consumption; Greenhouse Effect; Exhaust Emission; Standardization; Climatology

20010057626 NASA Ames Research Center, Moffett Field, CA USA

Atmospheric Aerosols

Pueschel, R. F., NASA Ames Research Center, USA; [1994]; 2p; In English

Contract(s)/Grant(s): RTOP 464-14-16-10; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

Aerosols, defined as particles and droplets suspended in air, are always present in the atmosphere. They are part of the earth-atmosphere climate system, because they interact with both incoming solar and outgoing terrestrial radiation. They do this directly through scattering and absorption, and indirectly through effects on clouds. Submicrometer aerosols usually predominate in terms of number of particles per unit volume of air. They have dimensions close to the wavelengths of visible light, and thus scatter radiation from the sun very effectively. They are produced in the atmosphere by chemical reactions of sulfur-, nitrogen- and carbon-containing gases of both natural and anthropogenic origins. Light absorption is dominated by particles containing elemental carbon (soot), produced by incomplete combustion of fossil fuels and by biomass burning. Light-scattering dominates globally, although absorption can be significant at high latitudes, particularly over highly reflective snow- or ice-covered surfaces. Other aerosol substances that may be locally important are those from volcanic eruptions, wildfires and windblown dust.

Author

Aerosols; Atmospheric Effects; Chemical Reactions; Biomass Burning; Terrestrial Radiation

20010058728 FROM, Emissions, Monitoring, and Analysis Div.

Supplement E to Compilation of Air Pollutant Emission Factors. Volume 1: Stationary Point and Area Sources. (Fifth Edition) ***Final Report***

Oct. 31, 1999; 258p; In English

Report No.(s): PB2001-105697; EPA/454/R-00/042; No Copyright; Avail: CASI; A12, Hardcopy; A03, Microfiche

This document contains emission factors and process information for more than 200 air pollution source categories. These emission factors have been compiled from source test data, material balance studies, and engineering estimates, and they can be used judiciously in making emission estimations for various purposes. When specific source test data are available, they should be preferred over the generalized factors presented in this document. This supplement to AP-42 addresses pollutant-generating activity from bituminous and sub-bituminous coal combustion; fuel oil combustion; wood waste combustion in boilers; lignite combustion; municipal solid waste landfills; waferboard/oriented strand manufacturing; particleboard manufacturing; medium density fiberboard manufacturing; wood preserving; western surface coal mines; and unpaved roads.

NTIS

Air Pollution; Exhaust Emission; Pollution Monitoring

20010058729 FROM, Emissions, Monitoring, and Analysis Div.

Quality Assurance Guidance Document. Quality Assurance Project Plan: PM 2.5 Speciation Trends Network Field Sampling ***Final Report***

Mikel, D.; Flanagan, J.; Musick, D.; Homalya, J.; Dec. 2000; 194p; In English

Report No.(s): PB2001-105696; EPA/454/R-01/001; No Copyright; Avail: CASI; A09, Hardcopy; A03, Microfiche

This section provides all parties involved in the Speciation Trends Network with a clear understanding of their roles and the lines of authority, communication, and reporting for the project. The organization of the STN involves three interacting entities: (1) Federal and Regional EPA offices, (2) state and local air monitoring and reporting organizations, and (3) one or more contracting laboratories to service the collection sites with supplies, sample analysis, and data reporting. to make the best use of available resources and to meet demanding timeliness for collection and analysis of samples, the flow of information and samples must be optimally organized. The deployment and operation of the network is a shared responsibility among all the involved parties. This section describes the roles of all parties and establishes the lines of communication and reporting, with the goal of facilitating a smoothly operating network.

NTIS

Air Quality; Particulates; Pollution Monitoring; Environmental Monitoring

20010058862 FROM, National Exposure Research Lab.
Proceedings US/Germany Workshop on Ozone/Fine Particle Science (6th)
Dimitriades, B.; Jost, D.; Oct. 2000; 428p
Report No.(s): PB2001-105529; EPA/600/R-00/076; No Copyright; Avail: CASI; A19, Hardcopy; A04, Microfiche
Contents include the following: Gas Phase Chemistry and Modeling; Heterogeneous Chemistry and Modeling; Measurement Methods; Environmental Chamber Studies; Reactivity Studies; New Chamber Projects.
NTIS
Conferences; Ozone; Air Pollution

20010058875 Environmental Protection Agency, Center for Environmental Research Information, Cincinnati, OH USA
Capsule Report: Hard Chrome Fume Suppressants and Control Technologies
Dec. 1998; 36p; In English
Report No.(s): PB2001-105628; EPA/625/R-98/002; No Copyright; Avail: National Technical Information Service (NTIS)
The hard chromium electroplating industry has been affected by numerous air quality regulations on both state and federal levels, In 1995, the U.S. Environmental Protection Agency promulgated its 'National Emission Standards for Chromium Emissions from Hard and Decorative Chromium Electroplating and Chromium Anodizing Tanks' (U.S. EPA, 1995 a). Under the standards, facilities that perform industrial or functional chrome plating must demonstrate that chromium emissions do not exceed acceptable limits, and must also satisfy monitoring, record-keeping and reporting requirements. Various chemical and mechanical strategies for air pollution control exist to accomplish these goals. This report evaluates the use of hardware control technologies and fume suppressants to extract, recover or suppress chromium emissions prior to venting the exhaust air to the atmosphere.
NTIS
Environment Protection; Pollution Control; Air Quality; Air Pollution; Chromium; Industrial Plants

20010058912 Energy and Environmental Analysis, Inc., Arlington, VA USA
Air Quality Procedures for Civilian Airports and Air Force Bases ***Final Report, Sep. 1995 - Apr. 1997***
Apr. 1997; 216p; In English
Contract(s)/Grant(s): DTFA01-96-Y-01002
Report No.(s): PB2001-104946; AEE-97-03; AL/EQ-TR-1996-0017; No Copyright; Avail: CASI; A03, Microfiche; A10, Hardcopy
Air Quality assessments for proposed Federal actions are required for compliance with the National Environmental Policy Act, the Clean Air Act and other environment-related regulations and directives. This handbook is a comprehensive guide intended to assist the air quality analyst in assessing the air quality impact of Federal Aviation Administration and USA Air Force actions at airports and air bases. It provides guidance, procedures and methodologies for use in carrying out such assessments.
NTIS
Environment Management; Air Quality; Military Air Facilities

20010058926 NASA Langley Research Center, Hampton, VA USA
Impact of Ship Emissions on Marine Boundary Layer NO(x) and SO2 Distributions over the Pacific Basin
Davis, D. D., Georgia Inst. of Tech., USA; Grodzinsky, G., Georgia Inst. of Tech., USA; Kasibhatla, P., Duke Univ., USA; Crawford, J., NASA Langley Research Center, USA; Chen, G., Georgia Inst. of Tech., USA; Liu, S., Georgia Inst. of Tech., USA; Bandy, A., Drexel Univ., USA; Thornton, D., Drexel Univ., USA; Guan, H., Georgia Inst. of Tech., USA; Sandholm, S., Georgia Inst. of Tech., USA; Geophysical Research Letters; Jan. 15, 2001; ISSN 0094-8276; Volume 28, No. 2, pp. 235-238; In English
Contract(s)/Grant(s): NCC1-306
Report No.(s): Paper-2000GL012013; Copyright; Avail: Issuing Activity
The impact of ship emissions on marine boundary layer (MBL) NO(x) and SO2 levels over the Pacific Ocean has been explored by comparing predictions (with and without ships) from a global chemical transport model (GCTM) against compiled airborne observations of MBL NO(x) and SO2. For latitudes above 15 N, which define that part of the Pacific having the heaviest shipping, this analysis revealed significant model over prediction for NOx and a modest under prediction for SO2 when ship emissions were considered. Possible reasons for the difference in NO(x) and SO2 were explored using a full-chemistry box model. These results revealed that for an actual plume setting the NO(x) lifetime could be greatly shortened by chemical processes promoted by ship plume emissions themselves. Similar chemical behavior was not found for SO2.
Author
Boundary Layers; Nitrogen Oxides; Ocean Surface; Sulfur Dioxides; Plumes

20010058945 NASA Langley Research Center, Hampton, VA USA

Stratospheric Water Vapor Increases Over the Past Half-Century

Rosenlof, K. H., National Oceanic and Atmospheric Administration, USA; Oltmans, S. J., National Oceanic and Atmospheric Administration, USA; Kley, D., Forschungszentrum Juelich G.m.b.H., Germany; Russell, J. M., III, Hampton Univ., USA; Chiou, E.-W., Science Applications International Corp., USA; Chu, W. P., NASA Langley Research Center, USA; Johnson, D. G., Harvard-Smithsonian Center for Astrophysics, USA; Kelly, K. K., National Oceanic and Atmospheric Administration, USA; Michelsen, H. A., Sandia National Labs., USA; Nedoluha, G. E., Naval Research Lab., USA; Geophysical Research Letters; Apr. 01, 2001; ISSN 0094-8276; Volume 28, No. 7, pp. 1195-1198; In English; Original contains color illustrations

Report No.(s): Paper-2000GL012502; Copyright; Avail: Issuing Activity

Ten data sets covering the period 1954-2000 are analyzed to show a 1% per year increase in stratospheric water vapor. The trend has persisted for at least 45 years, hence is unlikely the result of a single event but rather indicative of long-term climate change. A long-term change in the transport of water vapor into the stratosphere is the most probable cause.

Author

Climate Change; Stratosphere; Water Vapor; Trends

20010059346 NASA Marshall Space Flight Center, Huntsville, AL USA

Remote Sensing of Atlanta's Urban Sprawl and the Distribution of Land Cover and Surface Temperature

Laymon, Charles A., Universities Space Research Association, USA; Estes, Maurice G., Jr., Universities Space Research Association, USA; Quattrochi, Dale A., NASA Marshall Space Flight Center, USA; [2001]; 1p; In English; 97th Annual Meeting, 28 Feb. - 3 Mar. 2001, New York, NY, USA; Sponsored by Association of American Geographers, USA; No Copyright; Avail: Issuing Activity; Abstract Only

Between 1973 and 1992, an average of 20 ha of forest was lost each day to urban expansion of Atlanta, Georgia. Urban surfaces have very different thermal properties than natural surfaces-storing solar energy throughout the day and continuing to release it as sensible heat well after sunset. The resulting heat island effect serves as catalysts for chemical reactions from vehicular exhaust and industrialization leading to a deterioration in air quality. In this study, high spatial resolution multispectral remote sensing data has been used to characterize the type, thermal properties, and distribution of land surface materials throughout the Atlanta metropolitan area. Ten-meter data were acquired with the Advanced Thermal and Land Applications Sensor (ATLAS) on May 11 and 12, 1997. ATLAS is a 15-channel multispectral scanner that incorporates the LANDSAT TM bands with additional bands in the middle reflective infrared and thermal infrared range. The high spatial resolution permitted discrimination of discrete surface types (e.g., concrete, asphalt), individual structures (e.g., buildings, houses) and their associated thermal characteristics. There is a strong temperature contrast between vegetation and anthropomorphic features. Vegetation has a modal temperature at about 20 C, whereas asphalt shingles, pavement, and buildings have a modal temperature of about 39 C. Broad-leaf vegetation classes are indistinguishable on a thermal basis alone. There is slightly more variability (+/-5 C) among the urban surfaces. Grasses, mixed vegetation and mixed urban surfaces are intermediate in temperature and are characterized by broader temperature distributions with modes of about 29 C. Thermal maps serve as a basis for understanding the distribution of "hotspots", i.e., how landscape features and urban fabric contribute the most heat to the lower atmosphere.

Author

Land Use; Surface Temperature; Remote Sensing; Temperature Distribution; Chemical Reactions; Heat Islands; LANDSAT Satellites; Surface Properties; Thermodynamic Properties

20010059386 General Accounting Office, Washington, DC USA

Report to the Ranking Minority Member, Committee on Government Reform, House of Representatives. Air Pollution: EPA Should Improve Oversight of Emissions Reporting by Large Facilities

Apr. 2001; 38p; In English

Report No.(s): PB2001-105457; GAO-01-46; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

EPA performs limited oversight of states processes for verifying the accuracy of emissions reports submitted by major sources. In the four states included in our review, the approaches taken to verify the accuracy of the reports varied significantly. The state that performed the most detailed reviews found widespread inaccuracies. However, EPAs oversight of these processes is limited; the agency had audited only three permit authorities in the two EPA regions we visited and found that one of the three authorities had no process in place for verifying the accuracy of the emissions reports. While taking steps to improve its overall compliance-monitoring strategy, EPA does not plan to evaluate state processes for verifying emissions reports from large facilities.

NTIS

Congressional Reports; Ranking; Air Pollution; Pollution Monitoring

46
GEOPHYSICS

Includes earth structure and dynamics, aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism. For related information see 47 Meteorology and Climatology; and 93 Space Radiation.

20010055678 Massachusetts Inst. of Tech., Cambridge, MA USA
Topographic and Rotation Effects on Gravity-Wave Dynamics in the Atmosphere ***Final Report, 15 Mar. 1996-14 Nov. 2000***
Akylas, Triantaphyllos R.; Apr. 04, 2001; 4p; In English
Contract(s)/Grant(s): F49620-98-1-0388
Report No.(s): AD-A389004; AFRL-SR-BL-TR-01-0286; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

Theoretical models for the generation of gravity internal waves by flow over topography have been developed, in an effort to understand the role of orographically induced gravity waves in atmospheric turbulence production. For given background wind speed and distribution of buoyancy frequency, the location of the tropopause (the borderline between the troposphere and the stratosphere) is found to have a significant effect, consistent with observations of increased gravity-wave activity over New Mexico when the tropopause is 10-11 km above ground. Based on a finite-amplitude hydrostatic model that accounts for three dimensional effects, a theoretical explanation has been proposed for certain intense oblique gravity wave trains observed downstream of islands. Finally, the effects of periodic variations in the background buoyancy frequency have been studied, Under certain conditions, such fluctuations are found to cause trapping of mountain waves well below the tropopause while, in other instances, they result in unusually strong gravity-wave activity owing to a resonance phenomenon.
DTIC
Topography; Gravity Waves; Internal Waves; Atmospheric Models; Atmospheric Turbulence; Hydrostatics; Rotation; Stratosphere

20010055698 Silverman (S. M.), Lexington, MA USA
Low-Latitude Auroras: The Magnetic Storm of 14-15 May 1921
Silverman, S. M., Silverman (S. M.), USA; Cliver, E. W., Air Force Research Lab., USA; Journal of Atmospheric and Solar-Terrestrial Physics; 2001; ISSN 1364-6826; Volume 63, pp. 523-535; In English
Contract(s)/Grant(s): NASA Order W-21560; Copyright; Avail: Issuing Activity

We review solar geophysical data relating to the great magnetic storm of 14-15 May 1921, with emphasis on observations of the low-latitude visual aurora. From the reports we have gathered for this event the lowest geomagnetic latitude of definite overhead aurora (coronal form) was 40 deg and the lowest geomagnetic latitude from which auroras were observed on the poleward horizon in the northern hemisphere was 30 deg. For comparison, corresponding overhead/low-latitude values of 48 deg/32 deg and 41 deg/20 deg were reported for the great auroras on 28-29 August and 1-2 September 1859, respectively. However for the 1921 event, there is a report of aurora from Apia, Samoa, in the southern hemisphere, within 13 deg of the geomagnetic equator. This report by professional observers appears to be credible, based on the aurora description and timing, but is puzzling because of the discrepancy with the lowest latitude of observation in the northern hemisphere and the great implied aurora height (approximately 2000 km, assuming overhead aurora at Auckland, New Zealand). We discuss various possibilities that might account for this observation.
Author
Auroras; Magnetic Storms; Geophysics; Visual Observation

20010056265 NASA Goddard Space Flight Center, Greenbelt, MD USA
Early Results from the MODIS Atmosphere Cloud Algorithms
Platnick, S., Maryland Univ. Baltimore County, USA; Ackerman, S. A., Wisconsin Univ., USA; King, M. D., NASA Goddard Space Flight Center, USA; Menzel, W. P., National Environmental Satellite Service, USA; Gao, B.-C., National Research Lab. of Metrology, Japan; [2000]; 1p; In English; American Geophysical Union Fall Meeting, 15-19 Dec. 2000, San Francisco, CA, USA; Sponsored by American Geophysical Union, USA; No Copyright; Avail: Issuing Activity; Abstract Only

The Moderate Resolution Imaging Spectroradiometer (MODIS) is one of five instruments aboard the Terra Earth Observing System platform launched in December 1999. With 36 spectral bands from the visible through the infrared, and spatial resolution from 250m to 1km, the instrument provides an unprecedented opportunity for global cloud studies. A comprehensive set of remote sensing algorithms for cloud masking and retrieval of cloud physical and optical properties have been developed by members of the MODIS atmosphere team. The archived products from these algorithms have applications in climate change studies, climate modeling, numerical weather prediction, as well as fundamental atmospheric research. In addition to an extensive cloud mask, products include cloud top physical parameters (temperature, pressure, emissivity), cloud phase, cloud optical parameters (optical

depth, effective particle radius, water path), visible cirrus reflectance, a contrail flag, and other derived parameters. All products are archived into two categories: pixel-level retrievals at a 1 km or 5 km spatial resolution at nadir (referred to as Level-2 products) and 1 degree global gridded statistics (Level-3 products). An overview of the MODIS atmosphere algorithms and products, their status, validation activities, and early level-2 and -3 results will be presented.
Author
Imaging Spectrometers; Algorithms; Remote Sensing; Spectroradiometers; Cloud Physics; Climate Models; Spectral Bands

20010056294 NASA Goddard Space Flight Center, Greenbelt, MD USA
Atmospheric Chemistry from Space: Present Status and Future Plans
Schoeberl, Mark R., NASA Goddard Space Flight Center, USA; [2001]; 1p; In English; ASPRS Meeting, 27 Apr. 2001, Saint Louis, MO, USA; No Copyright; Avail: Issuing Activity; Abstract Only

One of the unqualified successes of the earth observation program is NASA's continuing monitoring of the ozone layer from space. This activity began in the early 70's with research instruments and continues to this day with the TOMS instrument series and the Upper Atmosphere Research Satellite. In the near future, NASA will be launching the EOS Aura spacecraft (launch mid-2003) which will continue our study of the chemical processes that produce stratospheric ozone depletion. In addition, Aura will begin the first global study of lower atmospheric air pollution including urban ozone, aerosols, nitrogen oxides and carbon monoxide. Atmospheric air pollution measurements from earth orbit involve the development of very high precision spectrometer technologies that have never been flown in space. Farther into the future, lower atmospheric ozone and aerosols may be monitored by space based lidars in low earth orbit, by sensors in geostationary orbit and by continuous limb observations instrument from the Lagrange point L2.
Author
Total Ozone Mapping Spectrometer; Pollution Monitoring; Ozone; Atmospheric Composition; Earth Observations (From Space)

20010056297 NASA Goddard Space Flight Center, Greenbelt, MD USA
MODIS Retrievals of Cloud Optical Thickness and Particle Radius
Platnick, S., Maryland Univ. Baltimore County, USA; King, M. D., NASA Goddard Space Flight Center, USA; Ackerman, S. A., Wisconsin Univ., USA; Gray, M., Emergent Technologies Corp., USA; Moody, E., Emergent Technologies Corp., USA; Arnold, G. T., Emergent Technologies Corp., USA; [2000]; 1p; In English; American Geophysical Union Fall Meeting, 15-19 Dec. 2000, San Francisco, CA, USA; Sponsored by American Geophysical Union, USA; No Copyright; Avail: Issuing Activity; Abstract Only

The Moderate Resolution Imaging Spectroradiometer (MODIS) provides an unprecedented opportunity for global cloud studies with 36 spectral bands from the visible through the infrared, and spatial resolution from 250 m to 1 km at nadir. In particular, all solar window bands useful for simultaneous retrievals of cloud optical thickness and particle size (0.67, 0.86, 1.2, 1.6, 2.1, and 3.7 micron bands) are now available on a single satellite instrument/platform for the first time. An operational algorithm for the retrieval of these optical and cloud physical properties (including water path) have been developed for both liquid and ice phase clouds. The product is archived into two categories: pixel-level retrievals at 1 km spatial resolution (referred to as a Level-2 product) and global gridded statistics (Level-3 product). An overview of the MODIS cloud retrieval algorithm and early level-2 and -3 results will be presented. A number of MODIS cloud validation activities are being planned, including the recent Southern Africa Regional Science Initiative 2000 (SAFARI-2000) dry season campaign conducted in August/September 2000. The later part of the experiment concentrated on MODIS validation in the Namibian stratocumulus regime off the southwest coast of Africa. Early retrieval results from this regime will be discussed.
Author
Optical Thickness; Optical Properties; Spectroradiometers; Imaging Techniques; Imaging Spectrometers; Stratocumulus Clouds; Ice Clouds

20010056300 Colorado Univ., Center for the Study of Earth from Space, Boulder, CO USA
Sedimentary Facies Analysis Using AVIRIS Data: A Geophysical Inverse Problem
Boardmann, Joe W., Colorado Univ., USA; Goetz, Alexander F. H., Colorado Univ., USA; [1990]; 10p; In English
Contract(s)/Grant(s): NGT-50490; NGT-958039; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

AVIRIS data can be used to quantitatively analyze and map sedimentary lithofacies. The observed radiance spectra can be reduced to 'apparent reflectance' spectra by topographic and reflectance characterization of several field sites within the image. These apparent reflectance spectra correspond to the true reflectance at each pixel, multiplied by an unknown illumination factor (ranging in value from zero to one). The spatial abundance patterns of spectrally defined lithofacies and the unknown illumination factors can be simultaneously derived using constrained linear spectral unmixing methods. Estimates of the minimum uncertainty

in the final results (due to noise, instrument resolutions, degree of illumination and mixing systematics) can be made by forward and inverse modeling. Specific facies studies in the Rattlesnake Hills region of Wyoming illustrate the successful application of these methods.
Author
Thematic Mapping; Radiance; Spectra; Sedimentary Rocks; Reflectance

20010056404 FROM
Lateral Ramps in the Folded Appalachians and in Overthrust Belts Worldwide: A Fundamental Element of Thrust-Belt Architecture
Pohn, H. A.; 1999; 78p; In English
Report No.(s): PB2001-104831; USGS-BULL-2163; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche
Lateral ramps are zones where decollements change stratigraphic level along strike; they differ from frontal ramps, which are zones where decollements change stratigraphic level perpendicular to strike. In the Appalachian Mountains, the surface criteria for recognizing the subsurface presents of lateral ramps include (1) an abrupt change in wavelength or a termination of folds along strike, (2) a conspicuous change in the frequency of mapped faults or disturbed zones (extrememly disrupted duplexes) at the surface, (3) long, straight river trends emerging onto the coastal plain or into the Appalachian Plateaus province, (4) major geomorphic discontinuities in the trend of the Blue Ridge province, (5) interruption of Mesozoic basins by cross-strike border faults, and (6) zones of modern and probable ancient seismic activity. Additional features related to lateral ramps include tectonic windows, cross-strike igneous instructions, areas of giant landslides, and abrupt changes in Paleozoic sedimentation along strike.
NTIS
Geological Faults; Appalachian Mountains (North America); Coastal Plains; Geomorphology; Structural Properties (Geology); Tectonics

20010056443 Colorado Univ., Center for the Study of Earth from Space, Boulder, CO USA
Application of Atmospherically Corrected Reflectance Spectra From HIRIS to the Identification and Mapping of Aeolian Components in Soils ***Final Report***
Goetz, Alexander F. H., Colorado Univ., USA; [1995]; 6p; In English
Contract(s)/Grant(s): NAS5-31711; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche
This final report encompasses all efforts funded under NASA including the HIRIS team leader activities. The results of the HIRIS team efforts as a group is summarized in the HIRIS Science Requirements Document. The rest of the research effort is codified in a number of published papers in peer-reviewed journals and proceedings of scientific meetings. This report is organized into a series of topic headings where a short summary is given and the appropriate references cited. Copies of all the relevant papers are collected in the appendix.
Author
Infrared Spectrometers; Spectral Reflectance; Thematic Mapping

20010056934 State Univ. of New York, Atmospheric Sciences Research Center, Albany, NY USA
Review, Quality Assurance, and Application of Global Atmospheric Radon Data ***Final Report, 1 Jun. 1997 - 31 May 2000***
Kritz, Mark A., State Univ. of New York, USA; [2000]; 10p; In English
Contract(s)/Grant(s): NCC2-5212; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche
Because its physical source is generally well understood, its chemical sources and sinks negligible, and its physical sink dominated by its own radioactive decay (which occurs with a half-life of approximately 3.8 days) observations of ambient atmospheric gaseous radon concentrations have for many years played an important role in atmospheric science experiments. With the emergence of the global three-dimensional atmospheric circulation and chemical transport models that currently are playing a central role in our attempts to understand important global effects such as stratospheric ozone loss and global warming, the value of comparisons between the atmospheric radon distributions predicted by the models and those actually observed in the atmosphere (at all levels of the troposphere) has received growing recognition as a powerful means of independently assessing model performance. The basic idea is to introduce suitable radon source and sink functions into the models, and then to use comparisons between the measured and model-predicted atmospheric radon distributions to assess the performance of the transport components of the model in question. In recent years such comparisons have proved to be of considerable value in testing new global 3-D atmospheric models, identifying shortcomings in their transport parameterizations and spurring further model development. Radon is present in vanishingly small quantities in the atmosphere. Making high-quality radon measurements is entirely possible; however, it is at present an exacting, time-consuming, labor-intensive and costly process. But the need is there. Which brings us to the foci of this report. First, to address the question of whether there is a practical possibility, in the next five

years or so, of developing a radon measurement instrument which would have the requisite sensitivity and accuracy, together with the smaller package size, lower capital and operational costs, and less labor-intensive mode of operation necessary for routine, hopefully even unattended, operation? and second, to what degree can modelers rely upon airborne radon measurements made in the past, using the manual, precursor versions of these eventual instruments? to answer the questions I reviewed the current literature and the relevant measurement techniques, and visited three laboratories where airborne radon instrumentation with the potential to meet these demands is being or has been developed. In the balance of the report I will first review the properties and atmospheric distribution of radon, state operational goals for next-generation radon instrumentation, and make quantitative assessments of the performance, problems and potential, and the results obtained to date of four airborne radon measurement techniques.
Derived from text
Radon; In Situ Measurement; Measuring Instruments; Atmospheric Composition

20010058893 NASA Goddard Space Flight Center, Greenbelt, MD USA
AROTEL Temperature Retrievals Within PSC's Using Raman Scattering
Burris, John, NASA Goddard Space Flight Center, USA; McGee, Thomas, NASA Goddard Space Flight Center, USA; Hoegy, Walt, NASA Goddard Space Flight Center, USA; Heaps, William, NASA Goddard Space Flight Center, USA; Twigg, Larry, SM and A Corp., USA; Sumnicht, Grant, RITSS, USA; Hostetler, Chris, NASA Langley Research Center, USA; [2000]; 1p; In English; Fall American Geophysical Union Meeting, 15-19 Dec. 2000, San Francisco, CA, USA; Sponsored by American Geophysical Union, USA; No Copyright; Avail: Issuing Activity; Abstract Only

NASA Goddard Space Flight Center's Airborne Raman Ozone Temperature Lidar (AROTEL) made temperature retrievals within Polar Stratospheric Clouds (PSCs) on several flights during the SAGE III Ozone Loss and Validation Experiment (SOLVE) campaign. The location of the PSCs was confirmed using simultaneously acquired data from the NASA Langley Aerosol lidar. Retrievals were made on flight dates 991207, 991210 and 000127 from just above the aircraft to 25 kilometers geometric altitude. Raman temperature retrievals are, to first order, insensitive to Mie interference because the Raman signals are red shifted by 2331 cm(exp -1) from the initial laser wavelength. Backscattering from clouds and aerosols is consequently not observed by the detector; however, extinction does impact the measurement and limits retrievals to optically thin clouds. Comparisons between retrievals employing Rayleigh and Raman scattering show the Raman temperatures to be significantly warmer than those employing Rayleigh scattering. Uncertainties are a function of altitude: at 25 km they were approximately 3 K. Temperature profiles could not be retrieved for optically thick clouds.
Author
Atmospheric Temperature; Temperature Profiles; Ice Clouds; Polar Meteorology; Ozone

20010058914 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA USA
Microwave Observations and Modeling of O2 (1-delta(sub g)) and O3 Diurnal Variation in the Mesosphere
Sandor, Brad J., Jet Propulsion Lab., California Inst. of Tech., USA; Clancy, R. Todd, Space Science Inst., USA; Rusch, David W., Colorado Univ., USA; Randall, Cora E., Colorado Univ., USA; Eckman, Richard S., NASA Langley Research Center, USA; Siskind, David S., Naval Research Lab., USA; Muhleman, Duane O., California Inst. of Tech., USA; Journal of Geophysical Research; Apr. 20, 1997; ISSN 0148-0227; Volume 102, No. D7, pp. 9013-9028; In English
Contract(s)/Grant(s): NSF ATM-95-01288
Report No.(s): Paper-96JD03585; Copyright; Avail: Issuing Activity

The first microwave measurements of an electronically excited molecular species in the Earth's atmosphere are presented. Local thermodynamic equilibrium (LTE) rotational line emission from mesospheric O2(1-del(sub g)) was observed at a frequency of 255.01794 GHz (lambda is approx. 1.2 mm), employing the National Radio Astronomy Observatory (NRAO) millimeter facility at Kitt Peak, Arizona (32 N, 111 W). The pressure broadened line shapes of the O2(1-del(sub g)) spectra, which were obtained in January and April 1992 and in January and November 1993, are inverted to retrieve O2(1-del(sub g)) mixing profiles over the 50-70 km altitude region. The observed daytime abundances exceed ozone abundances in the lower mesosphere, which are separately retrieved with coincident O3 spectral line (249.7886 GHz) observations. The January and November 1993 observations are binned into 20-60 min time intervals to study O2(1-del(sub g)) diurnal behavior. Derived abundances of O2(1-del(sub g)) between 50 and 70 km for the four observation dates are 9%, 31%, 3%, and 26%, respectively, each +/- 10% higher than predicted, based on the simple photochemistry of lower mesospheric O2(1-del(sub g)). Modeled variation of [O2(1-del(sub g))] with time of day agrees with observed variation in that the observed difference between model and data abundances is constant throughout the daylight hours of each observation date. Model underprediction of [02(lAg)] is consistent with similar model underprediction of mesospheric [O3]. A perturbation to the photochemical model that forces decreased ozone chemical loss brings brings both model [O3] and [O2(1-del(sub g))] into agreement with the observations. O2(1-del(sub g))

abundances derived from these 1.2 mm observations agree with [O2(1-del(sub g))] values derived from comparable SME observations of the 1.27 micrometers emission, with assumption of a 3880 sec O2(1-del(sub g)) radiative lifetime. The 6800 sec O2(1-del(sub g)) radiative lifetime proposed by Mlynczak and Nesbitt is ruled out by the similar comparison.
Author
Microwaves; Ozone; Diurnal Variations; Mesosphere

47
METEOROLOGY AND CLIMATOLOGY

Includes weather observation forecasting and modification

20010054612 Woods Hole Oceanographic Inst., MA USA
The General Circulation of the Atmosphere: 2000 Program of Study in Geophysical Fluid Dynamics
Salmon, Rick, Woods Hole Oceanographic Inst., USA; Held, Isaac M., Woods Hole Oceanographic Inst., USA; March 2001; 196p; In English
Contract(s)/Grant(s): N00014-97-1-0934; NSF OCE-98-10647
Report No.(s): AD-A388836; WHOI-2001-03; No Copyright; Avail: CASI; A03, Microfiche; A09, Hardcopy

In its millennial session, the GED program focused on ”The General Circulation of the Atmosphere.” Isaac Held led the charge with an inspiring two-week introductory course, strongly supported by the lectures of Alan Plumb, Wayne Schubert, Michael Cullen, and Oliver Buehler. As the dust settled, the important concept of pseudomomentum shone brightly in the sky above Walsh Cottage. This is a concept which has virtually transformed meteorology within the past 20 years, yet it remains mostly unfamiliar to oceanographers and others. Thus our ”pseudomomentum summer”, perfectly fit the GFD mission of diffusing ideas across disciplinary boundaries. As the summer wore on, the range of topics broadened in its customary way to include: the general circulation of Jupiter and Mars; lattice-Boltzmann and gas-kinetic methods for solving the equations of fluid mechanics; the scattering of sound waves by vortices; the heating of the universe; and many more topics too numerous to list. For an accurate impression of the program’s activities, the reader should be sure to scan the 2000 lecture schedule. Our 9 GFD fellows--all attending American or Canadian universities, but representing America, Italy, Barbados, Greece, Ghana and China--seemed to thrive in this atmosphere, holding up well under the pressure of the full lecture schedule and the deadline for research projects. Once again I must apologize to the many excellent applicants who were not selected to be fellows.
DTIC
Atmospheric Circulation; Earth Atmosphere; Geophysics; Meteorology; Fluid Dynamics

20010055832 NASA Marshall Space Flight Center, Huntsville, AL USA
Decadal Trends of Atlantic Basin Tropical Cyclones (1950-1999)
Wilson, Robert M., NASA Marshall Space Flight Center, USA; May 2001; 32p; In English
Report No.(s): NASA/TP-2001-210991; NAS 1.60:210991; M-1017; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Ten-year moving averages of the seasonal rates for ’named storms,’ tropical storms, hurricanes, and major (or intense) hurricanes in the Atlantic basin suggest that the present epoch is one of enhanced activity, marked by seasonal rates typically equal to or above respective long-term median rates. As an example, the 10-year moving average of the seasonal rates for named storms is now higher than for any previous year over the past 50 years, measuring 10.65 in 1994, or 2.65 units higher than its median rate of 8. Also, the 10-year moving average for tropical storms has more than doubled, from 2.15 in 1955 to 4.60 in 1992, with 16 of the past 20 years having a seasonal rate of three or more (the median rate). For hurricanes and major hurricanes, their respective 10-year moving averages turned upward, rising above long-term median rates (5.5 and 2, respectively) in 1992, a response to the abrupt increase in seasonal rates that occurred in 1995. Taken together, the outlook for future hurricane seasons is for all categories of Atlantic basin tropical cyclones to have seasonal rates at levels equal to or above long-term median rates, especially during non-El Nino-related seasons. Only during El Nino-related seasons does it appear likely that seasonal rates might be slightly diminished.
Author
Hurricanes; Periodic Variations; Trends; Climate Change; Tropical Storms

20010056293 NASA Goddard Space Flight Center, Greenbelt, MD USA

Evolution of South China Sea Summer Monsoon During SCSMEX-98: An Application of TRMM Data for Regional Hydro-Climate Studies

Lau, K.-M., NASA Goddard Space Flight Center, USA; Li, Xiaofan, SM and A Corp., USA; [2000]; 1p; In English; American Geophysical Union Fall Meeting, 15-19 Dec. 2000, San Francisco, CA, USA; Sponsored by American Geophysical Union, USA; No Copyright; Avail: Issuing Activity; Abstract Only

Evolution of South China Sea (SCS) summer monsoon in May-June, 1998 is investigated by using NASA/Tropical Rainfall Measuring Mission (TRMM) Microwave Imager (TMI) and Precipitation Radar (PR) data and the SCS Monsoon Experiment (SCSMEX) data. The five-day mean moisture budget over the SCS region, and TMI surface rain rate, winds and divergence are calculated for the periods of pre-monsoon, onset, mature, and break. Results show that the SCS monsoon onset is triggered by the southward-propagating mid-latitude frontal system and the eastward-propagating intraseasonal oscillations. The disastrous flooding over the Yangtze River Basin in 1998 is caused mainly by the massive moisture transport by the lower-tropospheric prevailed westerly winds associated with the depression over the Bay of Bengal. The TRMM PR data are used to calculate the vertical distribution of fractional cover of Corrected Z-factor. Before the onset, the fractional cover 1-2% of 20-30 dBz appears around 2 km, indicating marine status clouds, During the monsoon onset and mature, the factional cover 34% of 25-35 dBz occurs below 6 km, indicating strong convection. The factional cover 5% of 20 dBz is around 8 km, which is indicative of large stratiform ice clouds. Yangtze River (YR) floods occurred as a part of the evolution of the East Asian summer monsoon. The rain rate over the YR shows out of phase with rainfall over the SCS. The vertical structures and statistical properties of clouds over the YR are compared with those over the SCS.

Author

Monsoons; Rain; Precipitation (Meteorology); Meteorological Radar; Microwave Imagery; Intraseasonal Variations

20010056408 Microelectronics Center of North Carolina, Research Triangle Park, NC USA

Improving the Accuracy of Mixing Depth Predictions from the Mesoscale Meterorological Model MM5 ***Final Report***

Alapaty, K. V., Microelectronics Center of North Carolina, USA; Seaman, N. L., Microelectronics Center of North Carolina, USA; May 30, 2000; 100p; In English

Contract(s)/Grant(s): ARB-96-391

Report No.(s): PB2001-104858; No Copyright; Avail: CASI; A02, Microfiche; A05, Hardcopy

This research work was initiated to determine modeling aspects that control the accuracy of the estimated mixed-layer depths over central California, calculated by meteorological models. Most importantly, the authors focused on surface and large-scale atmospheric process representations and studied their effects in controlling the growth of the daytime boundary layer over this region. First, using a 1-D boundary layer method, the authors studied and improved the representation of surface processes. They developed a technique to facilitate the assimilation of surface data into the model without damaging the modeled mixed-layer structures. Second, using the Mesoscale Model, Version 5 (MM5) with a nested-grid configuration, the authors studied the interactions of large-scale processes with the growth of the boundary layer. They performed several sensitivity studies to understand the interactions of processes and to weed out insignificant aspects of model configuration.

NTIS

Mesoscale Phenomena; Weather Forecasting; Boundary Layers; Air Pollution; Meteorological Parameters; Atmospheric Models

20010056689 NASA Ames Research Center, Moffett Field, CA USA

Airborne Sun photometry and Closure Studies in SAFARI-2000 Dry Season Campaign

Schmid, B., Bay Area Environmental Research Inst., USA; Russell, P. B., NASA Ames Research Center, USA; Pilewskie, P., NASA Ames Research Center, USA; Redemann, J., Bay Area Environmental Research Inst., USA; Livingston, J. M., SRI International Corp., USA; Hobbs, P. V., Washington Univ., USA; Welton, E. J., NASA Goddard Space Flight Center, USA; Campbell, J., Science Systems and Applications, Inc., USA; Holben, B. N., NASA Goddard Space Flight Center, USA; McGill, M., NASA Goddard Space Flight Center, USA; [2001]; 1p; In English; IAMAS, 10-18 Jul. 2001, Innsbruck, Austria

Contract(s)/Grant(s): RTOP 621-14-01; No Copyright; Avail: Issuing Activity; Abstract Only

From August 13 to September 25, the Southern African Regional Science Initiative's (SAFARI 2000) dry-season airborne campaign studied the complex interactions between the region's ecosystems, air pollution, atmospheric circulation, land-atmosphere interactions, and land use change. The field campaign was timed to coincide with the annual winter fire season in Southern Africa. This challenging campaign. which coordinated ground-based measurement teams, multiple research aircraft, and satellite overpasses across nine African nations, was head quartered at the Petersburg International Airport in South Africa's Northern Province. Among many others, unique coordinated observations were made of the evolution of massive, thick haze

layers produced by industrial emissions, biomass burning, marine and biogenic sources. The NASA Ames Airborne Tracking 14-channel Sunphotometer (AATS-14) was operated successfully aboard the University of Washington CV-580 during 24 data flights. The AATS-14 instrument measures the transmission of the direct solar beam at 14 discrete wavelengths (3501558 nm) from which we derive spectral aerosol optical depths (AOD), columnar water vapor (CWV) and columnar ozone. Flying at different altitudes over a fixed location allows derivation of layer AOD and CWV. Data taken during feasible vertical profiles allows derivation of aerosol extinction and water vapor density. In the talk, we show comparisons with ground-based AERONET sun/sky photometer results, with ground based MPL-Net lidar data, and with measurements from a lidar aboard the high flying ER-2 aircraft. We will use measurements from the Ames Solar Spectral Flux Radiometer to derive estimates of solar spectral forcing as a function of aerosol thickness. Validations of TOMS and Terra satellite aerosol and water-vapor retrievals will also be discussed.
Author
Air Pollution; Aerosols; Ecosystems; Land Use; Atmospheric Circulation

20010056740 Colorado Univ., Center for the Study of Earth From Space, Boulder, CO USA
Characterization of Cirrus Clouds From Multi-pass AVIRIS Data
Goetz, Alexander F. H., Colorado Univ., USA; [1994], pp. 41-43; In English
Contract(s)/Grant(s): NAS5-31711; ISBN 0-7803-1497-2; Copyright; Avail: Issuing Activity

The optical depth and reflectance from thin cirrus clouds are calculated from two passes of AVIRIS over a scene in Florida. One of the passes contained partial cirrus cover, the other did not. Optical depths of 0.2 were calculated and the reflectance of the cloud at 1.381 micrometers was 0.026 The detection limit for cirrus is approximately an order of magnitude less in reflectance.
Author
Cirrus Clouds; Optical Thickness; Reflectance

20010056744 NASA Ames Research Center, Moffett Field, CA USA
Reduction of Cloud Water in Ship Tracks: Observations and Large-Eddy Simulations
Ackerman, A. S., NASA Ames Research Center, USA; Stevens, D. E., Lawrence Livermore National Lab., USA; Toon, O. B., Colorado Univ., USA; Coakley, J. A., Jr., Oregon State Univ., USA; [2001]; 1p; In English; European Geophysical Society Meeting, 24 -31 Mar. 2001, Nice, France; No Copyright; Avail: Issuing Activity; Abstract Only

Ship tracks represent a natural laboratory to study the effects of aerosols on clouds. A number of observations and simulations have shown that increased droplet concentrations in ship tracks increase their total cross-sectional area, thereby enhancing cloud albedo and providing a negative radiative forcing at the surface and the top of the atmosphere. In some cases, cloud water has been found to be enhanced in ship tracks, which has been attributed to suppression of drizzle and implies an enhanced susceptibility of cloud albedo to droplet concentrations. However, more recently compiled observations indicate that cloud water is instead reduced in daytime ship tracks on average. Such a response is consistent with cloud-burning due to solar absorption by soot (the semi-direct radiative forcing of aerosols), recently suggested to be suppressing trade cumulus cloud coverage over the Indian Ocean. We will summarize observational evidence and present large-eddy simulations that consider these competing mechanisms in the effects of aerosols on cloud albedo.
Author
Large Eddy Simulation; Ships; Ocean Surface; Cumulus Clouds; Aerosols

20010058865 National Center for Atmospheric Research, Mesoscale and Microscale Meteorology Div., Boulder, CO USA
Development of a Next-Generation Regional Weather Research and Forecast Model
Michalakes, J.; Chen, S.; Dudhia, J.; Hart, L.; Klemp, J.; 2001; 12p; In English; Original contains color illustrations
Report No.(s): PB2001-105591; No Copyright; Avail: National Technical Information Service (NTIS)

The Weather Research and Forecast (WRF) project is a multi-institutional effort to develop an advanced mesoscale forecast and data assimilation system that is accurate, efficient, and scalable across a range of scales and over a host of computer platforms. The first release, WRF 1.0, was November 30, 2000, with operational deployment targeted for the 2004-05 time frame. This paper provides an overview of the project and current status of the WRF development effort in the areas of numerics and physics, software and data architecture, and single-source parallelism and performance portability.
NTIS
Weather Forecasting; Mesoscale Phenomena; Mesometeorology; Data Systems; Software Engineering; Atmospheric Physics

20010058876 FROM

Analysis of Urban Databases with Respect to Mesoscale Modeling Requirements

Brown, M. J.; Burian, S.; Mueller, C.; Aug. 2000; 8p; In English; Submitted to 3rd AMS Urban Environment Symposium, Davis, CA., on August 2000. Color illustrations reproduced in black and white. Prepared in cooperation with Arkansas Univ., Fayetteville; Original contains color illustrations

Report No.(s): PB2001-105645; LA-UR-00-2850; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

A number of different parameterization schemes are used in mesoscale models to approximate the effects of the urban canopy on the meteorological flow field. At a minimum, urban land use information is needed to help prescribe roughness and surface energy balance parameters. More complex urban canopy parameterizations require morphological information cross-correlated with land use, for example, average building height, plan area density, and building area density vs. height as a function of land use. In this paper, we look at two primary issues: (1) what are the characteristics of readily-available United States Geological Survey (USGS) land use data and (2) how are urban land use categories related to particular building morphological characteristics. In the first part of this paper, we compare the USGS land use data to newer, more detailed land use datasets collected in the Los Angeles and Phoenix metropolitan areas. In the latter half of this paper, we show how the urban land use categories correlate to building morphology for the Los Angeles area. Knowing the percentages of high density vs. low density housing, for example, allows us to better assign the appropriate building plan area density for these grid cells in a mesoscale model.

NTIS

Atmospheric Models; Land Use; Weather Forecasting; Mesoscale Phenomena

20010059593 Brookhaven National Lab., Oceanographic and Atmospheric Sciences Div., Upton, NY USA

Cloud Chemistry

Schwartz, S. E.; Mar. 2001; 16p; In English

Report No.(s): PB2001-106028; BNL-68172; No Copyright; Avail: National Technical Information Service (NTIS)

The term cloud chemistry is considered here to comprise both cloud composition and reactions that take place in clouds. Clouds are a very special subset of the atmosphere because they present substantial amounts of condensed-phase water (liquid or solid) that can dissolve gases that would otherwise be present in the gas phase, and as a consequence of condensed-phase reactions permit reactions to occur that would not otherwise occur or which would be much slower. In this sense clouds may be considered to serve as catalysts of atmospheric reactions. The uptake and reaction of material in clouds, especially sulfur and nitrogen oxides and acids, has received particular attention in the context of gaining improved understanding the processes responsible for acid deposition. Consequently the examples developed here focus on these chemical systems. However much of the resulting understanding of these phenomena is applicable more generally to other systems.

NTIS

Chemical Composition; Clouds (Meteorology); Chemical Reactions

48
OCEANOGRAPHY

Includes the physical, chemical and biological aspects of oceans and seas; ocean dynamics, and marine resources. For related information see also 43 Earth Resources and Remote Sensing.

20010054976 Woods Hole Oceanographic Inst., MA USA

Evidence from Gravity Anomalies for Interactions of the Marion and Bouvet Hotspots with the Southwest Indian Ridge: Effects of Transform Offsets ***Final Report, 1 Aug. 1995 - 31 Aug. 1998***

Georgen, Jennifer E.; Mar. 2001; 42p; In English

Contract(s)/Grant(s): DAAH04-95-1-0561

Report No.(s): AD-A388896; ARO-34876.1-RT-NDF; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The ultra-slow spreading Southwest Indian Ridge (SWIR) presents a unique environment to study the interactions between hotspots and ridges with highly segmented geometry. Using recently available satellite free-air gravity and shipboard bathymetry data, we obtain mantle Bouguer (MBA) and residual mantle Bouguer anomalies (RMBA) by removing from free-air gravity the attractions of seafloor topography, sediment thickness variations, a reference crust, and theoretically-predicted effects of lithospheric cooling. The Bouvet hotspot, previously observed to be associated with anomalous bathymetry and geochemistry near the Bouvet triple junction, has an MBA axial gravity low of 100 mGal, implying pronounced localized crustal thickening.

DTIC

Gravity Anomalies; Gravitation; Oceanography; Ridges

20010055575 FROM, Chesapeake Bay Program
Who's Who in the Chesapeake Bay Program
Apr. 2001; 132p
Report No.(s): PB2001-105398; CBP/TRS-253/01; EPA/903/R-01/005; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

The Chesapeake Bay Program is the unique regional partnership that has been directing and conducting the restoration of the Chesapeake Bay since the signing of the historic Chesapeake Bay Agreement of 1983. The Bay Program partners include the states of Maryland, Pennsylvania, and Virginia; the District of Columbia; the Chesapeake Bay Commission, a tri-state legislative body; the US Environmental Protection Agency, representing the federal government and participating advisory groups. As the largest estuary in the USA and one of the most productive in the world, the Chesapeake Bay was this nation's first estuary targeted for restoration and protection. In the late 1970s, scientific and estuarine research on the Bay pinpointed three areas requiring immediate attention: (1) nutrient over-enrichment, (2) dwindling underwater bay grasses, and (3) toxic pollution. Once the initial research was completed, the Bay Program evolved as the means to restore this exceptionally valuable resource.
NTIS
Chesapeake Bay (US); Pollution Control; Resources Management; Environment Protection; Water Pollution

20010055697 Kyoto Univ., Dept. of Geophysics, Japan
Upper Mantle P-wave Structure of the Northwestern Rim of the Pacific Ocean
Nakanishi, Ichiro, Kyoto Univ., Japan; Sugiyama, Tadashi, Shimizu-Minami High School, Japan; Memoirs of the Faculty of Science, Kyoto University; 2001; ISSN 0368-9689; Volume 42, No. 1, pp. 95-120; In English; Sponsored in part by the Kurata Science Foundation; Copyright; Avail: Issuing Activity

We analyzed the first and secondary waves recorded by the seismic network of the Research Center for Earthquake Prediction of Hokkaido University to obtain the upper mantle P-wave structure of the northwestern rim of the Pacific Ocean. We made a data set of 67 earthquakes which occurred at depths shallower than 100 km along the Kuril-Aleutian Arc (6 deg is less than Delta is less than 55 deg) from April, 1985, to December, 1986. We read the first and secondary arrival times and determined the slowness and azimuth at the center of the network. The travel times of the first arrivals are approximately identical with the J-B times in the distance range except for 14-20 deg, where they are earlier than the J-B times. The secondary waves are seen as back-branches in the travel time curve and positive gradients in the slowness curve in the distance ranges of 14-22 deg and 19-25 deg. We obtained the one-dimensional P-wave structure which could explain the observations of both the travel time and slowness very well. No low velocity zone exists in the uppermost mantle, where the velocity increases with depth in the depth ranges of 33-95 km and 165-200 km and is constant in between. There are two transition zones where the velocity increases rapidly at depths of 400 km and 700 km and a minor transition zone at 460 km. The prominent difference between this model and the models obtained by the previous studies, for example Fukao, is that it has no low velocity zone and the depth of the 660 km discontinuity is deep. Using a linear least-squares method with linear inequality constraints we made the tau-p inversion of the travel time data to obtain the best velocity model and the error bounds that include all velocity-depth curves which agree with the data within a statistical limit. The error bounds of the discontinuity at the depth of 700 km for a 95% confidence level of our model includes the 660 km discontinuity of Fukao's model. It might be a little difficult to suggest the regional difference in the depth of the 660 km discontinuity on the basis of rigid statistical consideration. However, our recent study on the P-wave structure using a different seismic network supports the depth of 700 km obtained here for the discontinuity.
Author
P Waves; Depth; S Waves; Earth Mantle

20010056937 Woods Hole Oceanographic Inst., Dept. of Geology and Geophysics, MA USA
Variations in Ambient Light Emission from Black Smokers and Flange Pools on the Juan de Fuca Ridge
White, S. N., Woods Hole Oceanographic Inst., USA; Chave, A. D., Woods Hole Oceanographic Inst., USA; Reynolds, G. T., Princeton Univ., USA; Gaidos, E. J., California Inst. of Tech., USA; Tyson, J. A., Bell Telephone Labs., Inc., USA; VanDover, C. L., College of William and Mary, USA; Geophysical Research Letters; 2000; Volume 22, pp. 1151-1154; In English
Contract(s)/Grant(s): NSF OCE-94-07774; Copyright; Avail: Issuing Activity

Ambient light emitted by high-temperature black smokers and flange pools on the Juan de Fuca Ridge was imaged using a new spectral imaging camera. Most of the light is emitted at long wavelengths (700-1000 nm) and corresponds well to thermal radiation from a body at the same temperature as the vents/flanges. However, black smokers also emit time-varying radiation in the visible region (400-650 nm) which cannot be explained by a thermal source. This visible radiation is 1-2 orders of magnitude greater than would be expected for purely thermal radiation; it exhibits variation with time, despite relatively constant vent temperatures; and it is not associated with the hottest part of the plume (i.e., the critics). Flange pools do not exhibit excess visible

light over that for a thermal source, suggesting that the light at smokers is caused by mechanisms related to turbulence, mixing, or precipitation.
Author
Flanges; Variations; Light Emission; Hydrothermal Systems

20010058861 FROM
Oil Spills in Coral Reefs: Planning and Response Considerations
Feb. 2001; 84p
Report No.(s): PB2001-105353; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

This guide is intended to serve several functions and several audiences. The authors hope that resource agency personnel, state and federal agencies, and responders of all types working in or planning for response in coral reef regions will find useful information here. It is not intended to be a specific guide for choosing cleanup methods, as many good versions of these exist already. Rather, the authors summarize current research on coral reefs from the perspective of those who may need to make decisions about response in these regions and present the information in an accessible format for people with some science or response background. Experienced responders unfamiliar with coral reefs may want background on coral ecology and terminology; biologists may want an overview of toxicity issues related to coral and response and cleanup applied to coral reefs in particular.
NTIS
Coral Reefs; Shorelines; Ecology; Toxicity

20010059596 Great Lakes Basin Commission, Ann Arbor, MI USA
Model Comprehensive State Management Plan for the Prevention and Control of Nonindigenous Aquatic Nuisance Species. Report to the Great Lakes States
Glassner-Shwayder, K.; Jan. 1996; 34p; In English
Report No.(s): PB2001-105401; No Copyright; Avail: CASI; A01, Microfiche; A03, Hardcopy

This document is a model to guide Great Lakes states in the development of state comprehensive management plans for the prevention and control of nonindigenous aquatic nuisance species as called for in the federal Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 (Public Law 101-646) (NANPCA). It is recommended that each state's plan include the following eight sections: (1) executive summary; (2) nonindigenous aquatic nuisance species (ANS) background; (3) policy background; (4) management actions; (5) implementation; (6) program monitoring and evaluation; (7) glossary; and (8) appendices. The executive summary should include a brief overview of the state management plan, including a statement of purpose for the plan. The nonindigenous ANS background should provide a brief history of the invasion of aquatic nuisance species in the Great Lakes region, including a state-specific historical perspective.
NTIS
Great Lakes (North America); Management Planning; Aquatic Plants; Ecosystems; Ecology

51
LIFE SCIENCES (GENERAL)

Includes general research topics related to plant and animal biology (non-human); ecology; microbiology; and also the origin, development, structure, and maintenance, of animals and plants in space and related environmental conditions. For specific topics in life sciences see categories 52 through 55.

20010051285 NASA Ames Research Center, Moffett Field, CA USA
Microbial Fossilization in Mineralizing Environments: Relevance for Mars "EXOPALEONTOLOGY"
Farmer, Jack D., NASA Ames Research Center, USA; DesMarais, David J., NASA Ames Research Center, USA; [1994]; 1p; In English; COSPAR Meeting, 11-21 Jul. 1994, Hamburg, Germany; Sponsored by Committee on Space Research, German Democratic Republic
Contract(s)/Grant(s): RTOP 185-52-82; No Copyright; Avail: Issuing Activity; Abstract Only

The goals of post-Viking exobiology include the search for a Martian fossil record. How can we optimize future exploration efforts to search for fossils on Mars? The Precambrian fossil record indicates that key factors for the long-term preservation of microbial fossils include: 1) the rapid entombment and/or replacement of organisms and organic matter by fine-grained, stable mineral phases (e.g. silica, phosphate, and to a lesser extent, carbonate), 2) low-permeability host sediments (maintaining a closed chemical system during early diagenesis), and 3) shallow burial (maintaining post-depositional temperatures and pressures within

the stability range for complex organic molecules). Modem terrestrial environments where early mineralization commonly occurs in association with microbial organisms include: subaerial thermal springs and shallow hydrothermal systems, sub-lacustrine springs and evaporites of alkaline lakes, and subsoil environments where hardpans (e.g. calcretes, silcretes) and duricrusts form. Studies of microbial fossilization in such environments provide important insights preservation patterns in Precambrian rocks, while also playing a role in the development of strategies for Mars exopaleontology. The refinement of site priorities for Mars exopaleontology is expected to benefit greatly from high resolution imaging and altimetry acquired during upcoming orbital missions, and especially infrared and gamma ray spectral data needed for determining surface composition. In anticipation of future orbital missions, constraints for identifying high priority mineral deposits on Mars are being developed through analog remote sensing studies of key mineralizing environments on Earth.
Author
Carbonates; Emission Spectra; Exobiology; Fossils; Imaging Techniques; Mars Surface; Microorganisms

20010054781 Salonit Anhovo, dd, Anhovo, Slovenia
Nonlinear State Estimation and Parameter Identification in Biological Wastewater Treatment ***Nelinearni algoritem za estimacijo stanj in identifikacijo parametrov sarznega bioloskega procesa***
Bavdaz, Gregor, Salonit Anhovo, dd, Slovenia; Hvala, Nadja, Jozef Stefan Inst., Slovenia; Kocijan, Jus, Politehnika Nova Gorica, Slovenia; Juricic, Dani, Jozef Stefan Inst., Slovenia; Electrotechnical Review; 2001; ISSN 0013-5852; Volume 68, No. 1, pp. 57-63; In Slovene; Copyright; Avail: Issuing Activity

Control of wastewater treatment processes is characterized by the fact that many process variables that show the current plant status are not measured on-line. They can only be determined in laboratory analyses. Estimation is therefore a prerequisite for performing those control tasks that rely on important process variables which cannot be measured directly. One such problem very often addressed in biological wastewater treatment is related to the dissolved oxygen (DO) concentration dynamics during aeration which is affected by two important process variables: R (t) which represents the oxygen consumption rate as a result of the respiration of microorganisms, and the K-La function which represents the oxygen transfer into the wastewater through aeration. The two variables are important for DO control and process diagnosis but are not measured in a way which is appropriate for on-line control. Therefore, they need to be estimated from the air-flow rate u (t) and DO measurements So (t). In this paper an alternative nonlinear algorithm is used to perform a similar task. The nonlinear algorithm is, in our case, based on the work of Friedland and Ciccarela. It consists of the simultaneous state estimation and parameter identification of a nonlinear process. The algorithm was tested in a closed loop where an on-off controller was used to obtain the necessary excitation signal. The algorithm was applied to a batch wastewater treatment process known as a sequencing batch reactor (SBR). The designed algorithm was tested on an SBR simulation model of a laboratory pilot plant programmed within the Matlab(Tm) -Simulink(Tm) environment. The results of the study indicate that the proposed nonlinear algorithm gives better performance than least squares estimation especially in the period of low process excitation. Further testing of the algorithm will be performed on the on-line signals from the laboratory plant operation.
Author
Algorithms; Feedback Control; Waste Water; State Estimation; Estimating; Control Simulation; Computerized Simulation

20010054972 Duke Univ., Medical Center, Durham, NC USA
Computer Aided Breast Cancer Diagnosis ***Final Report, 23 Sep. 1994-22 Sep. 2000***
Floyd, Carey E.; Oct. 2000; 27p; In English
Contract(s)/Grant(s): DAMD17-94-J-4371
Report No.(s): AD-A388926; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The long term goal of this work is to develop a computer aid for the decision for breast biopsy. In this project, an artificial neural network was developed to predict the outcome of biopsy from the mammographic features described in the BIRADS lexicon. The focus has been to optimize the performance of the artificial neural network as well as to investigate alternate decision models. Cases were acquired from Duke University, and all cases included biopsy proof of the presence or absence of malignancy. In testing, the computer aid was found to be able to reduce the number of benign lesions that would be biopsied by 40% while missing 2% of the malignancies. Several alternative classifier designs were found to be offer promise as well. The deployment of this system into regional care facilities and into private mammography practices could facilitate transferring the expertise currently present in only a few tertiary care centers to the public at large and to smaller and more rural settings and thus improve access for under-served populations.
DTIC
Cancer; Mammary Glands; Computer Techniques; Diagnosis

20010054973 Michigan Univ., Ann Arbor, MI USA

Developmental Approach to Characterizing the Invasion Gene Program in Breast Cancer ***Annual Report, 11 Aug. 1999-10 Aug. 2000***

Weiss, Stephen J.; Sep. 2000; 13p; In English

Contract(s)/Grant(s): DAMD17-97-1-7282

Report No.(s): AD-A388915; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The changes in the gene program of neoplastic cells that regulate the expression of an invasive phenotype are largely undefined. Direct comparisons of the gene expression profile displayed in normal and carcinomatous breast tissues have provided insights into the mechanisms underlying tumor progression. However, attempts to identify the gene products differentially expressed during invasion in vivo have been hampered by the fact that only a small percentage of the cells recovered from a tumor mass are actively engaged in invasive behavior at the time of isolation. Because tissue remodeling induced during mammary gland involution bears homology to early stages of carcinogenesis, the involuting mammary gland may be used to identify genes that control matrix turnover in cancerous states. to this end, we propose to (1) generate cDNA libraries from control versus involuting mouse mammary glands, (2) isolate differentially expressed genes during matrix remodeling, (3) identify differentially expressed genes that encode secretory proteins associated with the involution program and iv) identify human homologues of the mouse-derived matrix remodeling genes. The approach should allow for the identification of gene products relevant to breast cancer invasion.

DTIC

Cancer; Genes; Mammary Glands

20010054974 Vaccinex, L.P., Rochester, NY USA

Target Antigens for Breast Cancer Vaccines ***Annual Report, 1 Jul. 1999 - 30 Jun. 2000***

Cibotti, Ricardo; Jul. 2000; 21p; In English; Original contains color plates

Contract(s)/Grant(s): DAMD17-99-1-9419

Report No.(s): AD-A388914; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The prospects for development of well defined tumor vaccines has received great impetus from the demonstration that human melanoma express common antigens recognized by cytotoxic T cells (CTL). Although significant problems related to antigen delivery and immune stimulation remain to be resolved, the availability of molecularly defined breast tumor antigens would be a major step towards development of a vaccine for breast cancer. The most successful approaches to identify antigens uniquely expressed in tumor cells employ tumor-specific cytotoxic T cells to screen a library of gene products expressed in the tumor. We have developed a novel technology for this purpose that is far more efficient and sensitive than the available alternatives. This technology is being coupled with some novel methods to generate breast tumor-specific T cells for analysis.

DTIC

Antigens; Cancer; Cells (Biology); Mammary Glands; Vaccines

20010054980 Utah Univ., Salt Lake City, UT USA

Randomized Trial of Interleukin-2 (IL-2) as Early Consolidation Following Marrow Ablative Therapy with Stem Cell Rescue for Metastatic Breast Cancer ***Annual Report, 1 Oct. 1999-30 Sep. 2000***

Samlowski, Wolfram E.; Oct. 2000; 11p; In English

Contract(s)/Grant(s): DAMD17-99-1-9417

Report No.(s): AD-A388772; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Marrow ablative doses of chemotherapy followed by stem cell rescue (MAT/SR) produce a high frequency of objective responses in patients with metastatic breast cancer, with up to 40-50 % complete responses. Unfortunately, responses tend to be short-lived. Interleukin-2 (IL-2) can activate lymphocytes to kill multidrug resistant cancer cells. Our phase I data established that a single course of low-dose IL-2 (1.6 million IU/m2/day as a continuous i.v. infusion for 18 days) as consolidation treatment to patients with metastatic breast cancer earl after MAT/SR. Seven patients (60%) remained in complete remission at a median of 435 days (range: 24 - 720 days) post stem cell transplantation. We are therefore performing a larger scale phase II trial of MAT/SR, followed by a single 18-day continuous infusion of low-dose IL-2 to activate lymphocytes to kill residual chemotherapy-resistant cancer cells. Disease free survival and toxicity assessment represent major clinical aims (Specific aim 1). Immunologic effector mechanisms induced following MAT/SR by IL-2 infusion will be evaluated using phenotypic and functional assays for LAK cell induction (Specific Aim 2). Accrual to this study has been delayed due to a change from a randomized trial to a single arm phase

II study and due to negotiations between the University of Utah and the Army MRMC concerning liability clauses in the consent document. A finalized protocol has now been agreed upon.
DTIC
Cancer; Mammary Glands; Ablation; Bone Marrow; Immune Systems

20010054982 Michigan Univ., Ann Arbor, MI USA
Molecular Detection of Breast Cancer ***Final Report, 9 Jan. 1995-8 Jan. 2000***
Clarke, Michael F.; Feb. 2000; 116p; In English
Contract(s)/Grant(s): DAMD17-95-1-5021
Report No.(s): AD-A388768; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

Breast cancer is the second leading cause of cancer death among American women, with over 170,000 new cases and 50,000 deaths each year. Despite advances in detection and treatment, mortality from these diseases remains high. Traditional modes of treatment including radiation therapy, chemotherapy, and hormonal therapy have been useful but are limited by the emergence of treatment- resistant cancer cells. Clearly new approaches are needed to treat these diseases. This project is designed to develop novel approaches to detect breast cancer cells that contaminate peripheral blood and bone marrow, and to remove such contaminating cells. An RT-PCR assay has been developed to detect breast cancer cells, and a novel gene therapy vector has been developed to kill contaminating cancer cells. Blood and bone marrow samples obtained from patients with breast cancer are being collected. These samples will be analyzed to determine whether the K19 RT-PCR assay can be used to predict outcome. Next, a gene therapy vector, the bcl-xs adenovirus, has been developed. This vector has promise as a therapeutic agent for the treatment of breast cancer. With additional support from the National Cancer Institute, this virus is undergoing toxicology testing in order to obtain FDA approval for human clinical trials for the treatment of breast cancer.
DTIC
Cancer; Mammary Glands; Detection

20010054983 University of South Florida, Tampa, FL USA
Advanced Cancer Detection Center ***Annual Report, 1 Oct. 1999-30 Sep. 2000***
Ruckdeschel, John; Krischner, Jeffrey P.; Sutphen, Rebecca; Kumar, Nagi; Tockman, Melvyn; Oct. 2000; 145p; In English
Contract(s)/Grant(s): DAMD17-98-1-8659
Report No.(s): AD-A388766; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

The goals of the Advanced Cancer Detection Center include the discovery of molecular and genetic markers of cancer risk, the identification of individuals at high risk for cancer through screening, and the testing of methods to prevent cancer.
DTIC
Cancer; Detection; Genetics; Molecular Biology

20010055663 Miami Univ., FL USA
Cyclin D1, Anchorage-Independent Growth and Breast Cancer ***Annual Report, 15 Sep. 1999-14 Sep. 2000***
Welsh, Catherine, Miami Univ., USA; Oct. 2000; 19p; In English
Contract(s)/Grant(s): DAMD17-97-1-7013
Report No.(s): AD-A388640; No Copyright; Avail: CASI; A01, Microfiche; A03, Hardcopy

Proteins that regulate progression through the G1 phase, including cyclin Dl and the cyclin-dependent kinase (cdk) inhibitors p2l to the cip1 and p27 to the kipl, appear to be particularly important in the pathogenesis of breast cancer. We suggest that aggressive breast cancer will involve both (1)overexpression of cyclin Dl and (2) failure to undergo a compensatory upregulation of cdk inhibitors. The specific aims are designed to test these hypotheses in cell culture models, nude mice, and breast cancer biopsies. We have generated mouse embryo fibroblasts (MEFs) that stably and inducibly overexpress cyclin Dl. In contrast to the data in NIH-3T3 cells, there was no compensatory upregulation of p2l in MEFs in response to cyclin Dl overexpression. An analysis of several established breast cancer cell lines has thus far failed to show a relationship between levels of cyclin Dl and the cdk inhibitors, supporting the MEK data. Expression of cyclin Dl, p27, and p2l have been analyzed in samples of human lobular carcinoma by immunohistochemistry. It appears that, unlike ductal carcinoma, cyclin Dl is preferentially overexpressed in invasive components of lobular carcinoma. In addition, whereas there was no correlation between cyclin Dl or p2l and proliferation markers, p27 levels demonstrated an inverse correlation with markers of proliferation in human lobular carcinoma.
DTIC
Mammary Glands; Cancer; Culture Techniques; Pathogenesis; Proteins

20010055664 Harbor Branch Oceanographic Inst., Fort Pierce, FL USA

Investigation of Processes and Factors Regulating the Generation, Maintenance and Breakdown of Bioluminescent Thin Layers ***Annual Report, Jan. 2000-Mar. 2001***

Widder, Edith A., Harbor Branch Oceanographic Inst., USA; Mar. 2001; 6p; In English

Contract(s)/Grant(s): N00014-00-1-0176

Report No.(s): AD-A388642; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The field investigation for this project was conducted in Wilkinson Basin, Gulf of Maine (42 deg 20'N; 69 deg 47'W) from June 29 to July 6, 2000. Bioluminescent thin layers were located using the High-Intake-Defined Excitation-Bathyphotometer. Immediately following HIDEX-BP profiles the Johnson-Sea-Link submersible was launched with Dr. Katz's submersible holographic camera mounted on the upper work platform. Thin layers were located using real-time sensor feedback from intensified video recordings of stimulated bioluminescence. Over 600 single and double exposure holograms (the latter for velocity measurements) were recorded in the upper 100 m of the water column. Analysis is now underway to locate and identify articles within the holograms larger than 10 microns and to generate 3D vector arrays of instantaneous velocity distributions based on Holographic Particle Image Velocimetry.

DTIC

Bioluminescence; Holography; Real Time Operation; Cameras; Underwater Photography; Velocity Measurement; Particle Image Velocimetry

20010055665 State Univ. of New York, Albany, NY USA

Measurements of X-Ray Capillary Optics for Digital Mammography ***Final Report, 1 Sep. 1997-31 Aug. 2000***

Padiyar, Sushil D.; Sep. 2000; 40p; In English

Contract(s)/Grant(s): DAMD17-97-1-7166

Report No.(s): AD-A388726; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Results of extensive mammography screenings have shown the need for detection of breast cancer at earlier and more curable stages to have any significant impact on the mortality rate. While new imaging technologies for breast cancer diagnosis like magnetic resonance imaging, breast ultrasound and breast specific positron emission tomography are being developed, x-ray imaging continues to function as a convenient and economical choice for early detection.

DTIC

Cancer; Detection; Diagnosis; Imaging Techniques; Mammary Glands; Tomography; Ultrasonics; X Ray Imagery; Digital Systems; Radiography

20010055667 Chicago Univ., Chicago, IL USA

Improved MR Images of Breast Lesions with Fast Spectroscopic Imaging ***Annual Report, 15 Sep. 1999-14 Sep. 2000***

Karczmar, Gregory S.; Oct. 2000; 40p; In English

Contract(s)/Grant(s): DAMD17-99-1-9121

Report No.(s): AD-A388732; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The progress to date suggests that HiSS can be successfully implemented on clinical scanners and produce high quality images which contain information that is not available in conventional MR scans. HiSS MRI is particularly useful for detection of contrast agents. It is likely that HiSS will produce a significant increase in sensitivity and specificity of MRI for detection of breast cancer as well as other cancers. This means that cancers can be detected early when they are highly treatable. Earlier cancer detection is likely to improve clinical outcome for many cancer patients. During the next year of support we plan to continue to optimize HiSS MRI on the clinical scanner. At the same time, we will begin to scan patients with breast cancer to determine whether HiSS MRI provides significant increases in the sensitivity and accuracy of cancer detection and staging. We believe that based on the difficulty of optimizing HiSS data acquisition and analysis on clinical scanners, a limited amount of work using animal model tumors as a

DTIC

Clinical Medicine; Mammary Glands; Spectroscopy; Imaging Techniques; Cancer

20010055670 Pennsylvania Univ., Wistar Inst., Philadelphia, PA USA

Analysis BAP-1 as a Ubiquitin Hydrolase in the BRCA1 Pathway ***Annual Report, 1 Oct. 1999-30 Sep. 2000***

Schultz, David C.; Oct. 2000; 118p; In English; Original contains color plates

Contract(s)/Grant(s): DAMD17-98-1-8269

Report No.(s): AD-A388929; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

The recurrent theme that has emerged from the structural study of proteins is that multiple independently folded globular domain often cooperate in macromolecular recognition. These domains are often recognizable by conserved signature amino acid sequence motifs and their spatial organization within a novel protein is often the first clue to its biochemical function. The PHD finger and bromodomain are two highly conserved protein motifs found in proteins with transcriptional regulatory functions. Optima transcriptional repression by KAP-1, a universal corepressor for the KRAB-ZFP superfamily of transcriptional repressors, requires an intact PHD finger and bromodomain at its COOH-terminus. Naturally occurring mutations in the PHD finger contribute to a variety of human diseases including cancer. Site-directed mutations in the KAP-1 PHD finger or the bromodomain specifically disrupt the repression function of this bi-partite domain. We have determined a solution structure for the PHD finger of KAP-1. Our studies reveal that the PHD domain binds zinc in a cross-brace topology reminiscent of RING domains.
DTIC
Biochemistry; Amino Acids; Macromolecules; Genetics

20010055671 California Univ., San Diego, La Jolla, CA USA
Assessment of the Activation State of Ras and Map Kinase in Human Breast Cancer Specimens ***Final Report, 1 Sep. 1997-31 Dec. 2000***
Boss, Gerry R.; Jan. 2001; 21p; In English
Contract(s)/Grant(s): DAMD17-97-1-7031
Report No.(s): AD-A388934; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
Although genetic ras mutations are infrequent in breast cancer, Ras may be pathologically activated in breast cancer by overexpression of growth factor receptors which signal through Ras. We measured Ras activation in 20 human breast cancers and seven non-malignant breast samples and found Ras was highly activated in 11 of the cancers, i.e., more than two standard deviations above the mean of the benign samples; seven of these 11 cancers expressed both the epidermal growth factor (EGF) and the ErbB-2/neu/HER-2 receptors with the remaining four cancers with high Ras activation expressing one of these two receptors. In the remaining 9 cancers, Ras activation was similar to that observed in the benign breast samples with none of these cancers expressing the EGF receptor while one expressed the ErbB-2 receptor. None of the cancers tested had an activating K-ras mutation. The activity of mitogen-activated protein (MAP) kinase was high in the cancers and reflected the degree of Ras activation. In cultured mammary tumor cell lines, we showed that Ras activation was ligand dependent in cells overexpressing the ErbB-2 receptor. Thus, kas is abnormally activated in breast cancers overexpressing the EGF and/or ErbB-2 receptors indicating there are sufficient ligands in vivo to activate these receptors and this work provides a basis for new target-based treatments of human breast cancer.
DTIC
Cancer; Genetics; Mammary Glands; Mutations; Receptors (Physiology)

20010055673 Scripps Research Inst., La Jolla, CA USA
Cell Adhesion, Signaling and Myosin in Breast Cancer ***Annual Report, 1 Aug. 1999-31 Jul. 2000***
Sanders, Luraynne; Aug. 2000; 13p; In English; Original contains color plates
Contract(s)/Grant(s): DAMD17-97-1-7230
Report No.(s): AD-A388947; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
Cytoskeleton remodeling is crucial in many cellular events, including cell adhesion, spreading and motility. The Rho family of small GTPases (Rho, Rac and CDC42) are signal transducers that regulate cytoskeleton dynamics. However, little is known about the mechanisms by which Rho GTPases induce cytoskeletal changes. Here we show that Rac1 is important for cell spreading, a biological process in which the cytoskeleton is highly active. Overexpression of dominant negative or constitutively active Rac 1 significantly impairs the ability of the cells to spread. Rac activity is high only during early stages of spreading. The activity of p-21activating kinase (PAK), an effector molecule for Rac and CDC42, is also high only during the early stages of spreading. Overexpression of catalytically active PAK inhibits cell spreading and decreases myosin phosphorylation. Myosin is the cytoskeleton protein which provides the force generating ability to the actin cytoskeleton. Treatment of cells with myosin inhibitors also inhibits cell spreading. In vitro and in vivo studies revealed a novel target for PAK, myosin light chain kinase (MLCK), the enzyme that phosphorylates the light chain of myosin II. Activated PAK phosphorylates MLCK and inhibits its ability to phosphorylate MLC. Thus, PAK appears to modulate cytoskeleton changes by phosphorylation and downregulation of MLCK.
DTIC
Adhesion; Cancer; Mammary Glands; Muscles; Cells (Biology)

20010055675 Scripps Research Inst., La Jolla, CA USA
Adhesive Mechanisms in Breast Cancer Metastasis ***Annual Report, 1 Oct. 1999-30 Sep. 2000***
Felding-Habermann, Brunhilde; Oct. 2000; 62p; In English
Contract(s)/Grant(s): DAMD17-99-1-9368
Report No.(s): AD-A388954; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

The goal of this project is to understand adhesive mechanisms in breast cancer metastasis because this is the primary cause of death. Breast cancer metastasis to bone, lungs, liver and brain involves the blood stream and requires tumor cell arrest within the vasculature. In leukocytes and platelets, arrest within the vasculature depends on integrin activation. We found that breast cancer cells can express integrin alpha v beta 3 in an activated or a non-activated state. Only activated alpha v beta 3 supported breast cancer cell arrest during blood flow. The metastatic activity of breast cancer cells was strongly increased when alpha v beta 3 was activated.
DTIC
Adhesives; Cancer; Mammary Glands

20010055831 Washington State Univ., Pullman, WA USA
Cripto-1 in Mammary Gland Development and Carcinogenesis ***Final Report, 15 May 1997-15 Nov 2000***
Kinter, Randall L.; Hosick, H. L.; Dec. 2000; 23p; In English; Original contains color plates
Contract(s)/Grant(s): DAMD17-97-1-7117
Report No.(s): AD-A388939; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The purpose of this study is to evaluate the role of the growth factor Cripto-l (CR-1) in mammary development and carcinogenesis. During the final year of this grant we developed adenoviral vectors for the expression of CR-1 and cloned CR-3 from MCF-7 cells. We overexpressed CR-1 and CR-3 in MCF-7, Vero, and HC-11 cells, and found a dramatic difference in phenotype of the transduced cells. This may indicate that the few differences present between CR-1 and CR-3 are in functional regions of the protein. We are currently developing GFP-free adenoviral vectors and viruses that only contain one of the differences between CR-1 and CR-3 to define which of the amino acid differences are responsible for the difference in phenotype of transduced cells.
DTIC
Carcinogens; Mammary Glands; Proteins

20010056226 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA USA
Preliminary Mars Planetary Constants and Models for Mars Sample Return
Lyons, Dan, Jet Propulsion Lab., California Inst. of Tech., USA; Jan. 29, 1999; 6p; In English
Report No.(s): 312/99.DTL-1; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The following is a preliminary summary of the planetary constants and models that are recommended for use by the Mars Sample analysis and design.
Author
Mars Sample Return Missions; Mars Surface Samples; Mars (Planet); Constants; Models

20010056266 Georgetown Univ., Washington, DC USA
Primary Care and Regular Breast Cancer Screening Among Under-Served Minority Women ***Annual Report, 1 Aug. 1999 - 31 Jul. 2000***
OMalley, Ann; Aug. 2000; 57p; In English
Contract(s)/Grant(s): DAMD17-97-1-7131
Report No.(s): AD-A388565; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

The purpose of this study is to describe the components of primary care associated with adherence to regular breast cancer screening among low-income minority women. Its scope include secondary analyses of an existing dataset (completed-yr 1), conduction of focus groups (completed yr 2), and the development and conduction of a bilingual population-based telephone survey of lower income women over age 40 in Washington, D.C. to assess their experiences with breast cancer screening and its use in their primary care settings (yrs 2-3). Preliminary analyses of these data have been included in this annual report. Final analyses will be completed during year four. As described in the 2nd annual report, the PI obtained RO3 funding from NCI to expand the originally proposed survey from a clinic-based convenience sample to a population-based sample from throughout Washington, D.C. and to include cervical and colorectal cancer screening in addition to the main focus of breast cancer screening. The survey response rate was 86%. Two primary care variables, continuity of care (visit-continuity), and comprehensiveness of services (counseling) were consistently associated with adherence to screening for all cancers. Attainment of ”optimal” primary

care is strongly associated with adherence to breast, cervical and colorectal cancer screening for urban low income women of color. Findings will guide design of a future intervention that emphasizes important features of primary care in order to increase adherence to screening.
DTIC
Mammary Glands; Cancer; Minorities; Diagnosis

20010056270 Colorado Univ., Health Sciences Center, Denver, CO USA
Signaling Components of the Anti-Tumor Hormone Somatostatin in Breast Cancer Cells ***Annual Report, 22 Sep. 1999 - 21 Sep. 2000***
Tentler, John J.; Gutierrez-Hartmann,; Oct. 2000; 29p; In English
Contract(s)/Grant(s): DAMD17-97-1-7307
Report No.(s): AD-A388626; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The neuropeptide somatostatin is an important regulatory hormone that is widely distributed throughout the body. Somatostatin's actions are primarily inhibitory, and recently, it has been utilized as an antiproliferative agent against several tumor types, including breast neoplasms. Experimentally and clinically, somatostatin can inhibit breast cancer cell growth, possibly by inhibiting the secretion of growth factors, or by acting directly on the cells themselves to induce programmed cell death, or apoptosis. Despite increased clinical use, the mechanism(s) by which somatostatin acts to control breast cancer cell growth remain largely unknown. In this final report, I describe studies performed to survey of numerous breast cancer cell lines to predict their usefulness as models to study somatostatin action, which comprised Aim 1 of the proposal. One cell line, MDA231, shows a robust response to somatostatin with regard to growth factor stimulation of the mitogen activated protein kinase, ERK1/2 (or MAPK). Specifically, the somatostatin analog BIM23014 caused a marked dimunition of EGF-stimulated MAPK activity, likely mediated by the type 2 somatostatin receptor. Furthermore, I show data indicating that another signaling pathway, the jun n-terminal kinase (JNK) pathway may be activated in response to somatostatin. Together, these results begin to explain somatostatin's ability to inhibit cell growth and induce apoptosis in breast cancer. Identification of these target pathways defines functional assays by which the efficacy of future anti-cancer drugs can be tested.
DTIC
Cancer; Mammary Glands; Hormones; Cells (Biology); Chemotherapy

20010056511 Corey (Kenneth), USA
Scientific Tasks for Human: Plant Growth Experiments
Corey, Kenneth, Corey (Kenneth), USA; Workshop on Science and the Human Exploration of Mars; 2001, pp. 177-183; In English; See also 20010056494; No Copyright; Avail: CASI; A02, Hardcopy; A03, Microfiche

The bioregenerative functions performed by plants are vital to the sustainable management of human life in extreme environments and will require development of new methods and technologies for plant cultivation on Mars. Such methods will likely involve scenarios for cultivating plants in their own atmospheric environments and those directly integrated with human habitats. It will be desirable to use low-pressure atmospheres to reduce structural loads and start-up and maintenance masses for plant growth. Provision of human life support requirements by bioregenerative methods, engineering constraints for construction and deployment of plant growth structures on the surface of Mars, and in-situ resource utilization all suggest the use of hypobaric pressures for plant growth. Past work demonstrated that plants will likely tolerate and grow at pressures at or below one-tenth of sea level pressure on Earth. The use of atmospherically-isolated structures also enables the regulation of plant growth with atmospheric compositions tailored to the plant species. Geometric configurations of those structures will also influence resource requirements, light interception, and function of engineering designs. There are two broad categories of scenarios for the use of reduced pressures. First, there are scenarios that include direct integration of plants with human habitats or that permit ease of human entry to those habitats. Those habitats would involve the use of moderately low atmospheric pressures (40 to 70 kPa) and relatively high partial pressures of oxygen (14 to 21 kPa). Second, there will be a need for isolated plant growth habitats that will employ very low atmospheric pressures (5 to 40 kPa) potentially with a full range of oxygen partial pressures (1 to 21 kPa) and carbon dioxide partial pressures (0.1 to 10 kPa). The second set of conditions will involve the use of inflatable structures that will employ relatively thin, lightweight materials, capable of transmitting a maximum of ambient photosynthetically active radiation on the surface of Mars. Very few studies have been conducted in either area, but available literature strongly suggests the feasibility of the first (moderately low pressures) and hints at the feasibility of the second, though evidence at this point is scant. A general scientific objective driven by a long term presence of humans on Mars is to determine the atmospheric limits for normal plant growth and development. Specifically, limits of interest are low pressure, low partial pressure of oxygen, and partial pressure of carbon dioxide. As a corollary to this objective, it is of interest to answer the following question. Can plants grow and develop

normally at or slightly above the boiling point of water? This question arises from the constraints of materials resupply, material engineering, and the available photon flux available for plant growth on the Martian surface.
Derived from text
Mars Surface; Cultivation; Plants (Botany); Vegetation Growth

20010056902 NASA Ames Research Center, Moffett Field, CA USA
Effects of Hypergravity Exposure on Prolactin Levels in Pre-parturient , Parturient and Lactating Rat Dams
Baer. Lisa A., Lockheed Martin Corp., USA; Wade, Charles E., NASA Ames Research Center, USA; Ronca, April E., NASA Ames Research Center, USA; [2001]; 1p; In English; Annual Experimental Biology Meeting, 29 Mar. - 4 Apr. 2001, Orlando, FL, USA
Contract(s)/Grant(s): MH-46485; RTOP 121-10-40; RTOP 121-40-10; RTOP 121-10-50; No Copyright; Avail: Issuing Activity; Abstract Only

We analyzed the effects of 2.0-g, 1.75-g and 1.5-g hypergravity exposure on plasma concentrations of the lactotrophic hormone, prolactin (PRL), in female rats on pre-parturient (Gestation Day 20), parturient (Post-natal day 0) and lactating (P10) days. PRL levels have been found to be reduced in rat dams around the time of birth following exposure to gravitational loads varying from 2.16 to 3.14-g (Megory et. al., Aviation, Space and Environs 1129-1135, 1984). It has also been reported that at these high gravitational loads, neonatal mortality has been extremely high, suggesting a possible interaction between dam PRL concentration and neonatal outcome. We have previously reported no significant differences in PRL levels of parturient (PO) and lactating (P6 & P 15) dams when exposed to 1.5-g hypergravity, but did observe a slight elevation of PRL on PO and P 15, with a decrease on P6. In the present study, time-bred pregnant dams were exposed to either continuous 2.0-g, 1.75-g or 1.5-g centrifugation, beginning on Gestational day (G) 11 of the rats' 22-day pregnancy. We observed no significant differences in PRL concentrations between SC and any of the HG conditions. On G20 and PO, PRL concentrations of the 2.0-g and 1.5-g groups were slightly elevated as compared to SC. Similar to what we previously reported. PRL secretion was elevated in both HG and SC conditions on the day of birth relative to later during lactation, but on P10 it appeared to be reduced in HG relative to SC dams. These findings suggests that hypergravity slightly elevates plasma concentration of PRL in pre-parturient and lactating rat dams, with effects most pronounced during the periparturitional period and in a direction opposite to that observed following microgravity exposure.
Author
Microgravity; High Gravity Environments; Rats; Pituitary Hormones; Exposure; Hormones

20010057216 Massachusetts Inst. of Tech., Dept. of Physics, Cambridge, MA USA
Kinetic Evolution of Stable and Metastable State in Protein Solutions
Lomakin, A., Massachusetts Inst. of Tech., USA; Asherie, N., Massachusetts Inst. of Tech., USA; Benedek, G. B., Massachusetts Inst. of Tech., USA; Microgravity Materials Science Conference 2000; March 2001; Volume 1, pp. 98-102; In English; See also 20010057199; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A02, Hardcopy

The thermodynamic properties of protein solutions are important in many industrial, scientific, pharmacological and pathophysiological applications. These applications include the large scale separation of genetically engineered proteins, the production of crystals of biologically important proteins for the determination of their three-dimensional structure, the stability of highly concentrated pharmacological solutions of biological macromolecules and the inhibition of phase separation in protein condensation diseases. In all such applications the fundamental information required is the phase diagram of the macromolecule in question at various values of ionic strength, pH and temperature. Furthermore, it would be extremely valuable to be able to predict, even approximately, the location of the relevant phase boundaries. For this purpose it is highly desirable to establish the generic features of the phase diagram of protein solutions. Phase diagrams have proven to be vitally important tools in the processing of a large variety of organic and inorganic materials, including metals, alloys, colloids and synthetic polymers. The phase behavior of protein solutions shares some general features with these systems. However, there are aspects of the phase behavior which make protein solutions unique. Proteins exhibit phenomena such as metastable liquid-liquid phase separation, aggregation, self-assembly, and gelation which are not seen in atomic and molecular systems. Our central objective is to investigate the phase behavior of protein solutions so as to effectively facilitate their materials processing. We have been using a combination of experimentation, computer simulations and analytical theory to discover the factors which determine the location of the phase boundaries of protein and colloidal solutions. We have recently succeeded in demonstrating that, for a sufficiently short range of interaction, liquid-liquid phase separation becomes metastable with respect to crystallization. We have observed

experimentally the metastability of liquid-liquid coexistence in gamma-crystallins, a family of proteins whose phase transitions are implicated in cataract formation.
Author
Proteins; Metastable State; Stability; Intermolecular Forces; Pharmacology; Macromolecules

20010057624 Texas Univ., M. D. Anderson Cancer Center, Houston, TX USA
Epitope Specific T Cell Immunity to Breast Cancer ***Annual Report, 1 Aug. 1999 - 31 Jul. 2000***
Ioannides, Constantin; Aug. 2000; 91p; In English
Contract(s)/Grant(s): DAMD17-97-1-7098
Report No.(s): AD-A388572; No Copyright; Avail: CASI; A01, Microfiche; A05, Hardcopy

Studies during the ongoing grant period demonstrated that: (1) the CTL epitope E75 is partial agonist for activation of CTL effector function. It frequently activates IFN-gamma secretion, but infrequently cytolysis. (2) Enhancement of E75 immunogenicity can be achieved by methylene (CH2)-extension at positions in the peptide determined by computer assisted modeling to point upwards and sideways (Alanine position 7). In addition enhanced survival and maintenance of cytolytic activity by E75 can be achieved by priming with the helper peptide G89 (HER-2:776-789) followed by stimulation with CH2-extended E75 (with 3CH2) on the linear side chain of Ala).
DTIC
Mammary Glands; Cancer; Immunity; Lymphocytes

20010057792 Search for Extraterrestrial Intelligence Inst., Mountain View, CA USA
Mars Sample Return and Biocontainment
Race, Margaret S., Search for Extraterrestrial Intelligence Inst., USA; Journal of the American Biological Safety Association; [1998]; Volume 3, No. 1, pp. 22-24; In English; Copyright; Avail: Issuing Activity

In its continuing exploration of the solar system, NASA currently has plans to launch a sample return mission to Mars as early as 2005. The design of such a mission will utilize a variety of contamination control measures, both on the outbound flight to Mars and during the return to Earth of the spacecraft and sample return canister. Biocontainment and quarantine will most certainly be required at a receiving facility where a comprehensive battery of tests will be done to determine if any living, replicating entities are included in the samples and whether the returned materials are harmful in any way to Earth's biota or ecosystems. The task of developing hardware, facilities, laboratory protocols, operations plans and certification standards for extraterrestrial materials will require input from many disciplines, including biosafety and public health experts. by combining basic principles of biocontainment with information about the nature and capabilities of microorganisms, a preliminary protocol has been developed for handling, containing and testing extraterrestrial samples. Plans for biocontainment facilities, quarantine, and testing methods for Mars sample return missions will also be important in planning future extraterrestrial sample returns from comets, moons and asteroids which also have the potential for harboring life.
Author
Mars Sample Return Missions; Containment; Planetary Quarantine; Protection; Mission Planning

20010059326 North Carolina Univ., Chapel Hill, NC USA
The Effects of the MHC Class II Transactivator on the Growth and Metastasis of Breast Tumors ***Final Report, 1 Jun 1997-31 May 2000***
Martin, Brian K., North Carolina Univ., USA; Ting, Jenny, North Carolina Univ., USA; Jun. 2000; 11p; In English
Contract(s)/Grant(s): DAMD17-97-1-7142
Report No.(s): AD-A388638; No Copyright; Avail: CASI; A01, Microfiche; A03, Hardcopy

I have finalized my research on the effects of the MHC class II transcriptional transactivator (CIITA) on the growth and metastasis of breast tumors. Mouse model systems have shown that CIITA expression, in and of itself, is at best not beneficial for tumor immunotherapy in the mouse model system. Surprisingly, even in the context of the immune costimulatory molecules CD8O (137-1) and CDB6 (137-2), CIITA was unable to mount and immune response in tumor challenged mice. When the system was modified to examine the ability of CIITA to induce immunogenicity of the tumor, it was found that CIITA was actually detrimental to survival. This result is not surprising considering that dogma in immunology states that engagement of the MHC-TCR complex without additional costimulation can lead to T cell anergy. What is surprising is that the classical costimulatory molecules CD8O and CD88 are unable to provide this T cell costimulation in the context of CIITA. Additional

experiments have also been undertaken to examine novel CIITA genes induced by CIITA. These studies provide a wealth of useful information regarding proposed human cancer therapy trials utilizing CIITA.
DTIC
Mammary Glands; Cancer; Therapy; Immunity

20010059375 Hahnemann Medical Coll. and Hospital, Philadelphia, PA USA
Tumor Suppressors and Breast Cancer ***Annual Report, 1 Sep. 1999 - 1 Sep. 2000***
Shyam, E.; Reddy, P.; Oct. 2000; 13p; In English
Contract(s)/Grant(s): DAMD17-99-1-9060
Report No.(s): AD-A388909; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Mutations in BRCA2 are responsible for about 35% of familial breast cancers and also a proportion of familial ovarian cancers. Both BRCA2 and BRCA1 proteins were shown to have transcriptional activation domains and also shown to be associated with RNA polymerase suggesting that these proteins may function as transcriptional factors and have a role in the regulation of transcription. Recent studies on enzymes responsible for histones acetylation and deacetylation revealed that some of the transcriptional factors function as histones acetyl transferases. Since BRCA2 showed transcriptional activation properties, we tested whether BRCA2 is associated with histones acetyltransferase. Our results suggested that BRCA2 is associated with histones acetyl transferase (HAT) activity. We propose to test whether HAT activity plays a role in tumor suppressor activity of BRCA2. We plan to identify the factors that associate with BRCA2 and study the role of these protein-protein interactions in the biochemical and biological properties of BRCA2. We intend test whether transcriptional activation function has any role in the tumor suppressor activity of BRCA2. We intend to identify the BRCA2 target genes and study (in future) their role in the tumor suppressor activity of BRCA2.
DTIC
Proteins; Genes; Suppressors; Cancer; Mammary Glands; Tumors

20010059933 Naval Health Research Center, San Diego, CA USA
Heart Rate Variability and Changes in Blood Volume ***Final Report, 1 Oct. 1999-30 Sep. 2000***
Hagan, R. D.; Buono, M. J.; Singh, S.; Blood, C. G.; Jan. 09, 2000; 19p; In English
Contract(s)/Grant(s): Proj-M2443
Report No.(s): AD-A388857; NHRC-00-40; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Combat casualty care requires that battlefield traumas be quickly and accurately assessed, and that patient's vital signs be continuously monitored to immediately detect small fluctuations that may have major implications for needed life-saving measures. Biomedical technologies are needed that will allow rapid initial assessment of the patient's condition and continuous monitoring of critical autonomic nervous system (ANS) activity.
DTIC
Medical Services; Heart Rate; Blood Volume; Variability

20010059934 Dana Farber Cancer Inst., Boston, MA USA
Prophylactic Mastectomy: Impact and Intervention ***Annual Report, 1 Oct. 1999-30 Sep. 2000***
Patenaude, Andrea; Oct. 2000; 35p; In English
Contract(s)/Grant(s): DAMD17-99-1-9162
Report No.(s): AD-A388864; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Prophylactic mastectomy (PM). the surgical removal of a healthy breast is a risk reduction option offered to women at increased genetic risk of breast cancer. There is limited data on the psychological effects of PM on body image self-esteem marital and family relationships etc. A psychological consultation offered to women making this irreversible decision would likely improve decision-making and subsequent coping. The design of this consultation is best informed by data about physical and emotional effects of surgery from women who have had this procedure. This project aims to gather such data through taped telephone interviews with women who had both breasts removed prophylactically (N-25) women with cancer in one breast who had both breasts removed (N-5O) and women considering PM (N-5O). We aim to determine (1) emotional and interpersonal effects of PM. (2) what women at increased risk of breast cancer anticipate the effects of PM surgery to be. and (3) if women in both groups believe psychological consultation about PM is useful. to date. interview schedules have been completed, pilot interviews conducted and analyzed. surgeons successfully involved in patient review and permission. and IRB approval finalized. Subjects are now being enrolled and interviews scheduled.
DTIC
Genetics; Mammary Glands; Cancer; Females; Psychological Effects

20010059935 Duke Univ., Medical Center, Durham, NC USA

Definition of the Cellular Mechanisms Which Distinguish Between Estrogen Receptor Agonists and Antagonists ***Annual Report, 1 Jul. 1999-30 Jun. 2000***

Chang, Ching-yi; McDonnell, Donald; Jul. 2000; 45p; In English; Original contains color plates

Contract(s)/Grant(s): DAMD17-99-1-9173

Report No.(s): AD-A388867; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Estrogen is a mitogen in most estrogen receptor (ER) positive breast cancers and anti-estrogens like tamoxifen have been the mainline therapies for these types of cancers. Although patients initially respond well to anti-estrogens, resistant tumors often develop within 5-10 years of treatment. The purpose of this research is to develop mechanistically distinct therapeutics by directly blocking the interaction of ER with interacting coactivators required for its transcriptional activity. We have successfully probed the ER:coactivator interaction surfaces using peptides isolated from combinatorial phage display libraries. Several different classes of peptides were identified that recognized specific ligand-bound ER conformations. Using these peptides we were able to determine at least two functionally important protein-protein interaction surfaces on ER. One surface is exposed when the receptor is activated by pure agonists and the other surface is formed only when the receptor is bound by tamoxifen. We found a number of peptides that recognize the agonist-induced conformation which can block estradiol-induced ER transcriptional activity. Additionally, we also identified peptides that recognize tamoxifen-bound ER which can antagonize tamoxifen partial agonist activity when expressed in target cells. Both of these classes of peptides have potential to be developed into peptide antagonists for the treatment of breast cancers.

DTIC

Bacteriophages; Estrogens; Pharmacology; Protection; Cancer; Mammary Glands; Peptides

20010059936 Dana Farber Cancer Inst., Boston, MA USA

The Identification of Novel Ligands for Cell Surface Receptors ***Final Report, 1 Oct. 1997-30 Sep. 2000***

Silver, Pamela A.; Oct. 2000; 71p; In English; Original contains color plates

Contract(s)/Grant(s): DAMD17-97-1-7231

Report No.(s): AD-A388869; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

A general problem in metazoan biology is the identification of the specific ligands for transmembrane receptors. One goal of the original proposal was to selectively modify the physiology of the budding yeast Saccharomyces cerevisiae to speed the identification and study of ligand/receptor interactions - in particular that of erB2 given its involvement in breast cancer. Significant progress was made on development of a system that allows a rapid readout for interaction of a receptor with its corresponding ligand. A second approach involves a novel search for small interacting peptide aptamers that could be used as ligand mimics or inhibitors. Peptide aptamer libraries have been characterized and in doing so, a novel peptide effector of the cell cycle regulator Cdk4 was characterized.

DTIC

Ligands; Yeast; Saccharomyces; Peptides; Mammary Glands; Cancer

20010059937 Columbia Univ., New York, NY USA

Murine Models of Breast Cancer: Assessment of the Role of c-SRc in Mammary Tumorigenesis ***Annual Report, 1 Oct. 1999-30 Sep. 2000***

Alexandropoulos, Konstantina; Oct. 2000; 23p; In English

Contract(s)/Grant(s): DAMD17-99-1-9152

Report No.(s): AD-A388873; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Strong evidence exists that the c-SRc non-receptor tyrosine kinase plays a role in the pathology of human breast tumors. The purpose of this study is to examine the role of c-SRc in mammary tumorigenesis and elucidate the mechanisms that lead to tumor formation in an animal model for breast cancer. In our previous experiments we used SRc substrates that we cloned to activate c-SRc and study its signaling mechanisms. Using one of these substrates, Sin, we characterized a signaling cascade that is activated as a result of Sin binding to SRc and SRc- mediated Sin phosphorylation. We found that SRc-phosphorylated Sin recruits a signaling complex that leads to the activation of the small GTP-binding protein Rap 1. Rap 1 then activates the ERK kinase that in turn mediates SRc-dependent transcriptional activation. In addition, when we compared Sin-activated wild-type SRc and an oncogenic SRc protein we found that their signaling mechanisms differed in that, wild type SRc signaling is mediated by the Rap 1 cascade whereas oncogenic SRc signaling is mediated by Rap 1, as well as another G- protein, Ras. Our results for the first time implicate the Rap1 pathway in wild type and oncogenic SRc signaling and reveal mechanistic differences in the signaling mechanisms of these proteins. In our future experiments we will address the role of Rap1 activation in cellular transformation and mammary tumorigenesis in cell lines and transgenic mice coexpressing SRc and Sin. These experiments will provide insight into

the mechanisms of SRc- mediated tumorigenesis and may lead to the identification of proteins that will be used as targets for drug development.
DTIC
Mammary Glands; Cancer; Neoplasms; Tumors; Proteins; Phosphorylation; Carcinogens

20010059938 Tufts Univ., Boston, MA USA
Body Fat Phenotypes, Sex Hormones and Breast Cancer Risk in Postmenopausal African-American Women ***Annual Report, 30 Sep. 1999-29 Sep. 2000***
Barnett, Junaidah B.; Oct. 2000; 72p; In English; Original contains color plates
Contract(s)/Grant(s): DAMD17-99-1-9410
Report No.(s): AD-A388875; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche
African-American (AA) women have the highest breast cancer mortality rate in the U.S. Despite reports suggesting that breast cancer in AA women might be a biologically more aggressive disease, AA women, especially postmenopausal AA women, remain one of the least studied populations in this country, with very little known about their sex hormone profile. Recent findings have suggested that body fat distribution may be a better marker for breast cancer risk than degree of obesity. This is a 5-year cross-sectional study to determine the association between body fat phenotypes and sex hormone profile in postmenopausal AA women. For year one, we were able to successfully complete all necessary Tasks outlined in our approved statement of work, with the study running smoothly. This is a very challenging study to undertake. Study promotional efforts as well as the process of getting women through the study protocol are highly time-consuming and labor intensive. to date the number of interested callers is 162. of these, 40 did not return our calls, and 100 have already been telephone screened. Fifteen women are eligible, and 14 will be eligible at a later time. We are actively in the process of getting these women through the stud protocol.
DTIC
Hormones; Cancer; Females; Mammary Glands; Sex

20010059939 Thomas Jefferson Univ., Philadelphia, PA USA
IGF-IR, Cell Adhesion and Metastasis ***Annual Report, 15 Aug. 1999-14 Aug. 2000***
Surmacz, Ewa; Sep. 2000; 78p; In English
Contract(s)/Grant(s): DAMD17-99-1-9407
Report No.(s): AD-A388878; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche
The insulin-like growth factor I receptor (IGF-IR) is a multifunctional tyrosine kinase that has been implicated in breast cancer. Current evidence suggests an important role of the IGF-!R in the growth and survival of ER-positive primary breast tumors. However, the function of the IGF-IR in breast cancer metastasis is unknown. Previously we have shown that IGF-I modulates cell-cell and cell-substrate adhesion in breast cancer cells. Consequently, we proposed to investigate the molecular mechanism of IGF-IR-stimulated cell adhesion, and the role of IGF-IR overexpression in breast metastasis. We demonstrated that the IGF-IR promotes E-cadherin-dependent cell-cell adhesion and interacts with the elements of E-cadherin adhesion complex. IGF-IR overexpression or stimulation of cells with IGF-I improved the expression of one of the E-cadherin-associated proteins, ZO- 1. This was paralleled by augmented binding of the IGF-lR to ZO- I and to ZO-l-associated-alpha-catenin and actin. In parallel, we pursued IGF-IR function in E-cadherin negative metastatic breast cancer cells. We demonstrated that in this cellular context, IGF-I has no growth or adhesion function, but it is necessary to stimulate cell motility. The IGF-I-induced motility was mediated through PI-3 and p38 kinases, and was inhibited by the activation of ERKl/ERK2 kinases.
DTIC
Cancer; Adhesion; Mammary Glands; Tyrosine; Tumors; Stimulation

20010059940 Virginia Univ., Charlottesville, VA USA
Involvement of the Tyrosine Phosphatase SHP-1 in the Development of Breast Cancer ***Annual Report, 1 Oct. 1999-30 Sep. 2000***
Lorenz, Ulrike; Oct. 2000; 9p; In English
Contract(s)/Grant(s): DAMD17-98-1-8347
Report No.(s): AD-A388879; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche
To test the working hypothesis that SHP- 1 is essential for controlling growth and differentiation of mammary epithelial cells and that its dysregulation contributes to the development of breast cancer.
DTIC
Mammary Glands; Cancer; Tyrosine; Hypotheses

20010059944 Scripps Research Inst., La Jolla, CA USA
A Role for Laminin-5 in Human Breast Cancer Invasion ***Annual Report, 1 Sep. 1997 - 31 Aug. 2000***
Giannelli, Gianluigi; Sep. 2000; 26p; In English; Original contains color plates
Contract(s)/Grant(s): DAMD17-97-1-7218
Report No.(s): AD-A388922; No Copyright; Avail: CASI; A01, Microfiche; A03, Hardcopy

Extracellular matrix proteins (SCM) play a key role in tissue remodeling and tumor progression. We have shown that matrix metalloproteinase (MMP-2) cleaves Ln-5 and promotes cell migration. We report here that the expression of MMP-2 and the cleavage of Ln-5 correlate with the tissue remodeling of the mammary gland in vivo and in vitro as well. Sex steroids stimulate the development of the gland, with the occurrence of new buds and branches. In this situation Ln-5 was detected in the cleaved form, and MMP-2 concentrated along the mammary epithelial cells penetrating in the fat pad. A remodeling of the mammary gland tissue with a concomitant cleavage of Ln-5 was also observed in cultured mammary gland tissue These results suggest that a cleavage of Ln-5 by MMP-2 might be regulated by sex steroids and that this could contribute to tissue remodeling and cancer metastasis. An alternative possibility is that MTl-MMP could cleave Ln-5, in those cells that do not express MMP-2. We demonstrated that MTl-MMP is also able to promote cell migration via Ln-5 cleavage. Several evidences suggest that this mechanism might be largely diffuse in cancer tissues and the cleavage of Ln-5 could be relevant for tumor progression and metastasis.
DTIC
Mammary Glands; Hormones; Cancer; Sex; Cells (Biology)

20010059945 North Carolina State Univ., Dept. of Biochemistry, Raleigh, NC USA
Elucidating Mechanisms of Bacterial Response ***Final Report, 1 Aug. 1999 - 31 Jan. 2001***
Cavanagh, John; Jan. 31, 2001; 11p; In English
Contract(s)/Grant(s): DAAD19-99-1-0343
Report No.(s): AD-A388924; ARO-40293.8-LS; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The overall goal of this project was to determine whether protein flexibility contributed to molecular recognition and binding events for proteins critical in the development of bacterial virulence. Such a correlation would provide for an as yet untapped focal point for anti-infective design.
DTIC
Bacteria; Proteins; Responses

52
AEROSPACE MEDICINE

Includes the biological and physiological effects of atmospheric and space flight (weightlessness, space radiation, acceleration, and altitude stress) on the human being; and the prevention of adverse effects on those environments. For psychological and behavioral effects of aerospace environments see 53 Behavioral Science. For the effects of space on animals and plants see 51 Life Sciences.

20010054736 NASA Johnson Space Center, Houston, TX USA
Endothelium Preserving Microwave Treatment for Atherosclerois
Carl, James R., Inventor, NASA Johnson Space Center, USA; Arndt, G. Dickey, Inventor, NASA Johnson Space Center, USA; Fink, Patrick W., Inventor, NASA Johnson Space Center, USA; Beer, N. Reginald, Inventor, NASA Johnson Space Center, USA; Henry, Phillip D., Inventor, NASA Johnson Space Center, USA; Pacifico, Antonio, Inventor, NASA Johnson Space Center, USA; Raffoul, George W., Inventor, NASA Johnson Space Center, USA; May 01, 2001; 24p; In English; Division of US-Patent-Appl-SN-129832, filed 5 Aug. 1998, which is a continuation-in-part of US-Patent-Appl-SN-641045, filed 17 Apr. 1996
Patent Info.: Filed 9 Feb. 2000; NASA-Case-MSC-22724-2; US-Patent-6,226,553; US-Patent-Appl-SN-501150; US-Patent-Appl-SN-129832; US-Patent-Appl-SN-641045; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Method and apparatus are provided to treat atherosclerosis wherein the artery is partially closed by dilating the artery while preserving the vital and sensitive endothelial layer thereof. Microwave energy having a frequency from 3 GHz to 300 GHz is propagated into the arterial wall to produce a desired temperature profile therein at tissue depths sufficient for thermally necrosing connective tissue and softening fatty and waxy plaque while limiting heating of surrounding tissues including the endothelial layer and/or other healthy tissue, organs, and blood. The heating period for raising the temperature a potentially desired amount about 20 C, with the atherosclerotic lesion may be less than about one second. In one embodiment of the invention, a radically beveled waveguide antenna is used to deliver microwave energy at frequencies from 25 GHz or 30 GHz to about 300 GHz and is focused

towards a particular radical sector of the artery. Because the atherosclerotic lesions are often asymmetrically disposed, directable or focussed heating preserves healthy sectors of the artery and applies energy to the asymmetrically positioned lesion faster than a non-directed beam. A computer simulation predicts isothermic temperature profiles for the given conditions and may be used in selecting power, pulse duration, beam width, and frequency of operation to maximize energy deposition and control heat rise within the atherosclerotic lesion without harming healthy tissues or the sensitive endothelium cells.
Official Gazette of the U.S. Patent and Trademark Office
Arteriosclerosis; Surgical Instruments; Microwave Frequencies

20010054740 NASA Johnson Space Center, Houston, TX USA
Endothelium Preserving Microwave Treatment for Atherosclerosis
Carl, James R., Inventor, NASA Johnson Space Center, USA; Arndt, G. Dickey, Inventor, NASA Johnson Space Center, USA; Fink, Patrick W., Inventor, NASA Johnson Space Center, USA; Beer, N. Reginald, Inventor, NASA Johnson Space Center, USA; Henry, Phillip D., Inventor, NASA Johnson Space Center, USA; Pacifico, Antonio, Inventor, NASA Johnson Space Center, USA; Raffoul, George W., Inventor, NASA Johnson Space Center, USA; Apr. 24, 2001; 24p; In English; Division of US-Patent-Appl-SN-129832, filed 5 Aug. 1998 which is a continuation-in-part of US-Patent-Appl-SN-641045, filed 17 Apr. 1996 Patent Info.: Filed 9 Feb. 2000; NASA-Case-MSC-22724-3; US-Patent-6,223,086; US-Patent-Appl-SN-504768; US-Patent-Appl-SN-129832; US-Patent-Appl-SN-641045; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Method and apparatus are provided to treat atherosclerosis wherein the artery is partially closed by dilating the artery while preserving the vital and sensitive endothelial layer thereof. Microwave energy having a frequency from 3 GHz to 300 GHz is propagated into the arterial wall to produce a desired temperature profile therein at tissue depths sufficient for thermally necrosing connective tissue and softening fatty and waxy plaque while limiting heating of surrounding tissues including the endothelial layer and/or other healthy tissue, organs, and blood. The heating period for raising the temperature a potentially desired amount, about 20 C. within the atherosclerotic lesion may be less than about one second. In one embodiment of the invention, a radically beveled waveguide antenna is used to deliver microwave energy at frequencies from 25 GHz or 30 GHz to about 300 GHz and is focused towards a particular radial sector of the artery. Because the atherosclerotic lesions are often asymmetrically disposed directable or focussed heating preserves healthy sectors of the artery and applies energy to the asymmetrically positioned lesion faster than a non-directed beam. A computer simulation predicts isothermic temperature profiles for the given conditions and may be used in selecting power, pulse duration, beam width, and frequency of operation to maximize energy deposition and control heat rise within the atherosclerotic lesion without harming healthy tissues or the sensitive endothelium cells.
Official Gazette of the U.S. Patent and Trademark Office
Arteriosclerosis; Surgical Instruments; Microwave Frequencies; Heating

20010055674 Rutgers - The State Univ., Piscataway, NJ USA
The Influence of Gender, Age, and Ethnicity on Core Thermosensitivity and Responses to Cold ***Final Report, 25 Aug. 1995-24 Aug. 2000***
Zambraski, Edward; Glickman-Weiss, Ellen; Sep. 2000; 87p; In English
Contract(s)/Grant(s): DAMD17-95-C-5076
Report No.(s): AD-A388952; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

This investigation evaluated the influence of gender and phase of menstrual cycle. The purpose of this investigation was to therefore determine if central thermosensitivity differs between males and females, or, if menstrual cycle phase age, ethnicity or age would affect central thermosensitivity. In addition, it is uncertain if central thermosensitivity (as determined in water) is correlated to a cold air tolerance test.
DTIC
Ethnic Factors; Age Factor; Cold Tolerance

20010055677 Brigham and Women's Hospital, Boston, MA USA
Activity Monitoring Equipment ***Progress Report, 1 Jun.-30 Nov. 2000***
Czeisler, Charles; Mar. 20, 2001; 5p; In English
Contract(s)/Grant(s): F49620-00-1-0322
Report No.(s): AD-A388996; AFRL-SR-BL-TR-01-0243; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

To evaluate the impact of sleep and waking alertness on the operational success of Air Force personnel, a system of individual monitoring is required. Monitoring is essential for evaluating the operational readiness of critical personnel, predicting individual differences in performance during sustained operations and jet-lag/shift work operations, and for use as a selection tool to identify individuals who may be better suited for particular missions. The current research was designed to implement the use of an

unobtrusive ambulatory monitor (Actiwatch-L, Mini-Mitter Corporation, Bend, Oregon) to record ambient light level and wrist actigraphy of all subjects prior to the sleep deprivation jet-lag protocol; and to develop and conduct near-real-time analysis of these sleep and light exposure data. Data collected from these individuals will be analyzed using our most recent mathematical model that predicts waking alertness and neurobehavioral performance as well as circadian phase from activity (sleep-wake) and light history.
DTIC
Sleep Deprivation; Flight Crews; Activity (Biology); Mathematical Models; Real Time Operation; Data Acquisition; Physiological Factors

20010055683 Army War Coll., Carlisle Barracks, PA USA
Medical Intelligence: A Theater Engagement Tool
Kaufman, Denis C.; Feb. 21, 2001; 39p; In English
Report No.(s): AD-A389063; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Of all the intelligence challenges in the post-cold war world, medical issues are emerging as one of the most important. Increasingly our policymakers recognize that disease, environmental pollution, and health systems' failures threaten peace, stability, and economic progress throughout the developing world, shaping environments on terms other than ours and, at times, necessitating U.S. humanitarian and peacekeeping involvement. Medical intelligence is one tool that helps national policy makers, theater commanders and operational planners employ the medical instrument to best effect. to be properly employed, however, medical intelligence must be viewed as an intelligence function more than a medical function. Further, medical intelligence assets need to be distributed through the spectrum of intelligence support-strategic, operational, and tactical.
DTIC
Diseases; Policies; Medical Science; Intelligence; Health; Medical Services

20010056317 NASA Johnson Space Center, Houston, TX USA
In Vivo Simulator for Microwave Treatment
Arndt, G. Dickey, Inventor, NASA Johnson Space Center, USA; Carl, James R., Inventor, NASA Johnson Space Center, USA; Raffoul, George W., Inventor, NASA Johnson Space Center, USA; Karasack, Vincent G., Inventor, NASA Johnson Space Center, USA; Pacifico, Antonio, Inventor, NASA Johnson Space Center, USA; Pieper, Carl F., Inventor, NASA Johnson Space Center, USA; Jan. 16, 2001; 22p; In English; Division of US-Patent-Appl-SN-641045, filed 17 Apr. 1996
Patent Info.: Filed 16 Sep. 1998; NASA-Case-MSC-22483-2; US-Patent-6,175,768; US-Patent-Appl-SN-154622; US-Patent-Appl-SN-641045; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Method and apparatus are provided for propagating microwave energy into heart tissues to produce a desired temperature profile therein at tissue depths sufficient for thermally ablating arrhythmogenic cardiac tissue to treat ventricular tachycardia and other arrhythmias while preventing excessive heating of surrounding tissues, organs, and blood. A wide bandwidth double-disk antenna is effective for this purpose over a bandwidth of about 6 GHz. A computer simulation provides initial screening capabilities for an antenna such as antenna. frequency, power level, and power application duration. The simulation also allows optimization of techniques for specific patients or conditions. In operation, microwave energy between about 1 GHz and 12 GHz is applied to monopole microwave radiator having a surface wave limiter. A test setup provides physical testing of microwave radiators to determine the temperature profile created in actual heart tissue or ersatz heart tissue. Saline solution pumped over the heart tissue with a peristaltic pump simulates blood flow. Optical temperature sensors disposed at various tissue depths within the heart tissue detect the temperature profile without creating any electromagnetic interference. The method may be used to produce a desired temperature profile in other body tissues reachable by catheter such as tumors and the like.
Official Gazette of the U.S. Patent and Trademark Office
Temperature Profiles; Medical Equipment; Heart; Microwaves

20010056409 National Inst. of Neurological Diseases and Stroke, Bethesda, MD USA
Extramural Research and Training Awards
2000; 42p; In English
Report No.(s): PB2001-105004; NIH/PUB-01-1401; No Copyright; Avail: CASI; A01, Microfiche; A03, Hardcopy

The report contains extramural research grant, contract, and training programs of the National Institute of Neurological Disorders and Stroke (NINDS) aim to identify, stimulate, and support research and research training on the prevention, diagnosis, and treatment of nervous system disorders and the basic science fundamental to them.
NTIS
Nervous System; Neurology; Research; Diseases; Diagnosis; Education

20010056518 Institute of Aviation Medicine, Koenigsbrueck, Germany

Physiological Consequences: Cardiopulmonary, Vestibular and Sensory Aspects

Welsch, H., Institute of Aviation Medicine, Germany; Albery, W., Air Force Research Lab., USA; Bles, W., Institute for Human Factors TNO, Netherlands; Human Consequences of Agile Aircraft; May 2001, pp. 49-58; In English; See also 20010056513; Original contains color illustrations; Copyright Waived; Avail: CASI; A02, Hardcopy

Maneuvers which first expose the pilot to less than 1 Gz, followed by an exposure to greater than 1 Gz (Push-Pull) can lead to problems. The aircraft's ability to reach high altitude within a very short time (due to a lift to weight ratio of more than 1) may produce new problems even during normal aircraft operation, e.g., decompression sickness (DCS). The incidence of vestibular problems may be increased by unconventional acceleration exposures. Sensory stimulations may be induced by high acceleration alterations in the roll, pitch, and yaw axes. Simultaneous combinations of aircraft accelerations in the x, y, and z axes can result in longitudinal, lateral, and vertical reaction forces on the pilot. Special restraints may be required for the agile aircraft pilot, especially in the lateral, Gy, direction. The support by an advanced G-protection garment may be needed. For carefree handling, the advanced G-protection device must work without any delay in time even during high acceleration transitions, must include high altitude protection, and must ensure pilot comfort. Furthermore special training devices are required such as the human centrifuge as a dynamic flight simulator (DFS) with a fully gimbaled system, and a spatial (dis)orientation device with an effective motion system. Pilot selection and medical survey with highly sophisticated diagnostic tools will become more and more important. The need of special physical training will be required to enhance the aerobic endurance and the anaerobic power, to train the cardiovascular reflexes, and to increase psychomotoric stability and mental mobility.

Author

Physiological Effects; Physiological Responses; Flight Operations; Human Factors Engineering

20010058863 Washington Univ., Seattle, WA USA

Case-Crossover Analysis of Fine Particulate Matter Air Pollution and Out-of-Hospital Sudden Cardiac Arrest ***Topical Report, Jun. 1997 - Sep. 1999***

Checkoway, H.; Levy, D.; Sheppard, L.; Kaufman, J.; Koenig, J.; Dec. 2000; 48p; In English

Contract(s)/Grant(s): RFA 94-2

Report No.(s): PB2001-105551; HEI/PR-99/00; Copyright; Avail: National Technical Information Service (NTIS)

Numerous recent epidemiologic studies report increases in the daily incidence of cardiovascular disease mortality and morbidity related to increases in daily levels of fine particulate matter (PM)(sup star) air pollution. This study sought to evaluate the possible association between the occurrence of out-of-hospital sudden cardiac arrest (SCA) and daily PM levels in the Seattle metropolitan area. The underlying hypothesis was that PM exposure may act as a cardiovascular trigger for SCA. A case-crossover study was conducted among 362 SCA cases identified by paramedics from October 1988 through June 1994. Cases were King County WA residents who were married, aged 25 to 74 years at the time of their SCA, with no prior history of clinically recognized heart disease or other life-threatening comorbid conditions.

NTIS

Particulates; Air Pollution; Cardiovascular System; Heart Diseases; Air Quality

20010058864 McGill Univ., Montreal, Quebec Canada

Identifying Subgroups of the General Population That May Be Susceptible to Short-Term Increases in Particulate Air Pollution: A Time-Series Study in Montreal, Quebec ***Topical Report, Jul. 1995 - Jun. 1999***

Goldberg, M. S.; Bailar, J. C.; Burnett, R. T.; Brook, J. R.; Tamblyn, R.; Oct. 2000; 134p; In English; Prepared in cooperation with Environment Canada, Toronto (Ontario) and Quebec Univ., Laval

Contract(s)/Grant(s): RFA 94-2

Report No.(s): PB2001-105552; HEI/PR-97/100; Copyright; Avail: National Technical Information Service (NTIS)

This study was undertaken in order to shed light on which groups of the general population may be susceptible to the effects of ambient particles. The objectives of the study were (1) to determine whether concentrations of particles in the ambient air of Montreal, Quebec, were associated with daily all-cause and cause-specific mortality in the period 1884 to 1993, and (2) to determine whether groups of the population had higher than average risks of death from exposure to particles. From the network of fixed-site air pollution monitors in Montreal the authors obtained daily mean levels of various measures of particles, gaseous pollutants, and weather variables measured at Dorval International Airport. The authors also used measurements of sulfate from an acid rain monitoring station 15 km southeast of the city (Sutton, Quebec).

NTIS

Air Pollution; Time Series Analysis; Particulates

20010058874 FROM

Outreach Notebook for the NIH Guidelines on Inclusion of Women and Minorities as Subjects in Clinical Research

2001; 92p

Report No.(s): PB2001-105618; NIH/PUB-97-4160; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

The Director of NIH, in consultation with the Director of the Office of Research on Women's Health and the Director of the Office of Research on Minority Health, shall conduct or support outreach programs for the recruitment of women and members of minority groups as subjects in projects of clinical research. The goal of this legislation is to increase the opportunities for obtaining critically important information with which to enhance health and treat disease among all Americans, and to detect and account for significant differences between genders or racial and ethnic groups where they exist. As part of its campaign to integrate these new guidelines into the biomedical and behavioral research infrastructure, the NIH has developed this notebook, a primer, outlining key issues in the recruitment and retention of individuals into studies. The suggestions presented in this notebook are not requirements that must be incorporated into research applications/proposals. They are presented to provide guidance to investigators and their research teams as they consider the scientific question(s), study design, and methods to facilitate appropriate enrollment of study participants.

NTIS

Clinical Medicine; Females; Health; Minorities

20010058884 Sinai Samaritian Medical Center, Lab. of Cell Biology, Milwaukee, WI USA

Effect of Space Flight on Adrenal Medullary Function ***Final Report, Period ending 31 Aug. 1999***

Lelkes, Peter I., Sinai Samaritian Medical Center, USA; [1999]; 4p; In English

Contract(s)/Grant(s): NAG2-1201; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

We hypothesize that microgravity conditions during space flight alter the expression and specific activities of the adrenal medullary CA synthesizing enzymes (CASE). Previously, we examined adrenals from six rats flown for six days aboard STS 54 and reported that microgravity induced a decrease in the expression and specific activity of rat adrenal medullary tyrosine hydroxylase, the rate limiting enzyme of CA synthesis, without affecting the expression of other CASE. In the past, we analyzed some of the is greater than 300 adrenals from two previous Space Shuttle missions (PARE 03 and SLS 2). The preliminary results (a) attest to the good state of tissue preservation, thus proving the feasibility of subsequent large-scale evaluation, and (b) confirm and extend our previous findings. With this grant we will be able to expeditiously analyze all our specimens and to complete our studies in a timely fashion.

Author

Microgravity; Adrenal Metabolism; Adrenal Gland; Space Shuttle Missions

20010059190 National Inst. for Occupational Safety and Health, Morgantown, WV USA

Morphometric Analysis of Alveolar Responses of F344 Rats to Subchronic Inhalation of Nitric Oxide ***Topical Report, Feb. 1995 - Jan. 1998***

Mercer, R. R.; Sep. 1999; 36p; In English

Contract(s)/Grant(s): RFPA 94-3

Report No.(s): PB2001-105550; HEI/RP-88/99; Copyright; Avail: National Technical Information Service (NTIS)

Nitric oxide (NO)(sup star), the principal airborne pollutant generated from combustion processes such as gas stoves, tobacco smoke, and burning of fossil fuels, is being tested as a therapeutic agent in clinical trials. A prior morphometric study of rats exposed for 9 weeks to 0.5 parts per million (ppm) NO demonstrated focal degeneration of the alveolar interstitium and increased numbers of fenestrated alveolar septa (Mercer et al. 1995). The limited size and distribution of defects in this NO exposure did not alter alveolar surface area or other morphometric indicators of lung function, but were of interest as the responses to inhaled NO appeared to differ from those produced by other oxidants such as ozone (O3) and nitrogen dioxide (NO2). Nitric oxide exposures at the same concentration and duration as prior morphometric studies of O3 and NO2 were necessary in order to make a comparison. This was the purpose of the current study in which F344 rats were exposed for 6 weeks to air, 2ppm NO, or 6 ppm NO.

NTIS

Combustion Physics; Nitric Oxide; Physiological Responses; Alveoli; Respiration; Air Pollution

53
BEHAVIORAL SCIENCES

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

20010055430 National Taiwan Univ. of Science and Technology, Dept. of Electronic Engineering, Taipei, Taiwan, Province of China

Two-Dimensional Gray-Level Object Recognition Using Shape-Specific Points

Yu, Kuo-Kan, National Taiwan Univ. of Science and Technology, Taiwan, Province of China; Hu, Neng-Chung, National Taiwan Univ. of Science and Technology, Taiwan, Province of China; Journal of the Chinese Institute of Engineers; March 2001; ISSN 0253-3839; Volume 24, No. 2, pp. 245-252; In English; Copyright; Avail: Issuing Activity

This paper defines the nth order radius weighted mean points (RWMP) where n is any integer, and shows that they are shape-specific with respect to a 2-D gray-level object under translation, rotation and scaling. The distances between these RWMP form a feature vector that is invariant to translation and rotation. To achieve the scale invariance, we can normalize the feature vector by dividing it by the distance between centroid and first order RWMP. The Euclidean distances between the normalized feature vectors of the input and reference objects are used as a dissimilarity measure to recognize the objects.
Author

Two Dimensional Models; Pattern Recognition

20010055573 Research and Technology Organization, Human Factors and Medicine Panel, Neuilly-sur-Seine, France

Officer Selection *Final Report la Selection des officiers*

Lescreve, F. J., Belgian Air Force, Belgium; May 2001; 154p; In English; CD ROM contains full text document in PDF format
Report No.(s): RTO-TR-034; AC/323(HFM-023)TP/26; ISBN 92-837-1067-3; Copyright Waived; Avail: CASI; C01, CD-ROM; A08, Hardcopy; A02, Microfiche

From the end of 1997 till mid 2000, members of the Research and Study Group 31 (RSG 31) from Belgium, Canada, Denmark, France, Germany, the Netherlands, the UK, and the USA focused on the topic of Officer Selection. In order to share information and foster a scientific and professional approach to Officer Selection, two major products were delivered. The first was a workshop on Officer Selection held in November 1999 from which the proceedings were published. The final report on Officer Selection is the second achievement of the RSG. After the introduction, an overview is given of the current officer selection practice. A detailed review of the systems used in the countries participating to the research and study group is given and a summary is provided. Then the main results of a survey on officer selection are presented. This survey covers the current practice in nineteen NATO and non-NATO countries. The actual questionnaire is also included. Following the description of the current practice, the search for an ideal system is commented, a conceptual approach is developed, the qualities of an officer are discussed, a personnel selection primer is given and guidelines for test-use are highlighted. The RSG is convinced that a re-examination of any national system in the light of the practice in other countries together with the scientific and professional guidelines developed in this report and reported at the RSG workshop, can significantly improve the outcome of the current officer selection practice.
Author

Personnel Selection; Decision Making

20010055659 Yuan-Ze Univ., Dept. of Electrical Engineering, Chung-Li, Taiwan, Province of China

Primary-View Perception on a Gray Image: Region Segmentation and Association

Huang, Hui-Yu, Yuan-Ze Univ., Taiwan, Province of China; Chen, Yung-Sheng, National Tsing Hua Univ., Taiwan, Province of China; Hsu, Wen-Hsing, Academia Sinica, Taiwan, Province of China; Journal of the Chinese Institute of Enginees; March 2001; ISSN 0253-3839; Volume 24, No. 2, pp. 221-235; In English
Contract(s)/Grant(s): NSC 89-2213-E-007-064; Copyright; Avail: Issuing Activity

The segmentation of scenes into perceptually meaningful partitions possessing a useful relationship among them is of great importance in image understanding. In this paper, an effective approach performing image segmentation and association among the segmented regions for a gray image is presented. An unsupervised segmentation process using a self-organization map (SOM) and spatial-distance computation is presented for the segmentation of clusters in our understanding system. An association process is developed for the construction of spatial relationships among the attended regions, which are obtained from the segmented clusters using fuzzy relations. The algorithms for each process are presented and exemplified with a series of illustrations. This approach is applied to simulating the primary-view perception on a natural gray image. Experiments show that the proposed

approach is feasible. A possible linguistic presentation, based on the attended regions and their relationships, is given for every test image.
Author
Segments; Imaging Techniques; Image Processing; Visual Perception

20010056517 Institut de Medicine Aerospatiale Armee, Bretigny sur Orge, France
Psychological Consequences
Grau, J. Y., Institut de Medicine Aerospatiale Armee, France; Human Consequences of Agile Aircraft; May 2001, pp. 39-48; In English; See also 20010056513; Copyright Waived; Avail: CASI; A02, Hardcopy

The technological design and developments already applied to a number of aircraft, which represent the basis of tomorrow's aircraft, tend to change the tasks performed by pilots. Since the 80s, automation and computerization have invaded cockpits, leading to a change in the role of pilots. Whereas pilots used to need competencies directed towards handling and navigating the aircraft, what is now increasingly required of them is the ability to manage complex systems. With the arrival of new concepts like supermaneuverability and superagility, it seems extremely important to try and understand the psychological consequences these concepts will have on pilots. Enabling new types of operation, supermaneuverability and superagility alter existing tasks and will probably create new ones, which will have their own psychological constraints. What makes these constraints different from those existing on present aircraft, and what consequences could they have on pilot performance? These two questions can be addressed by two preliminary comments: (1) As of today, supermaneuverability and superagility are still extremely novel concepts. Various prototype aircraft point to the developments, which will eventually make these concepts a reality in the near future, but there still is no such thing as real operational experience. The difficulty in accurately studying the consequences these future aircraft will have on pilots, lies in trying to define the exact role the pilot will be asked to play aboard; and (2) The psychological consequences studied will be limited to the consequences borne by the pilot in terms of taking and processing information. This chapter does not take into account psychological aspects based on personality or motivation. The definition of supermaneuverability and superagility, or rather agility, gives rise to two fields of investigation regarding psychological consequences. These fields, far from being independent from each other, must be combined to clearly describe the psychological consequences borne by pilots. But, for clarity and comprehensiveness, it is best to study them separately, initially. The first one, supermaneuverability, refers to aircraft aerodynamic capacities. The psychological effects on pilots generated by the physiological stress resulting from this capacity need to be studied. The second one, agility, is connected to the operational capacities of these aircrafts. The aircraft must be assessed as an element within a global system, where it is a vehicle laden with on-board systems helping it achieve its mission in an operational environment.
Author
Complex Systems; Pilot Performance; Psychological Effects; Maneuverability

20010056520 Swedish Armed Forces, Aeromedical Center, Stockholm, Sweden
Selection and Training
Linder, J., Swedish Armed Forces, Sweden; Tielemans, W., Royal Netherlands Air Force, Netherlands; Human Consequences of Agile Aircraft; May 2001, pp. 99-110; In English; See also 20010056513; Original contains color illustrations; Copyright Waived; Avail: CASI; A03, Hardcopy

A superagility training structure is discussed and presented. The agile pilot will in the new superagility arena be clearly dependent on both old training principles but also on training where some new interacting factors might come into play: (1) Selection plays a major role with physiological, intellectual and stress management resources; (2) Certain human constraints like musculoskeletal, cardiovascular, respiratory, sensory and mental are discussed; (3) Normal life and regular training do also have a definite implication also on flying; (4) Specific single task training where a pilot trains crucial abilities like G-tolerance, back/neck-tolerance and hypobarics. Today there is a lack in this area of specific training. Training devices for pilots regarding the sensory system and the cognitive performance are discussed; (5) Specific combined tasks training where the pilot have to train in a more complex way, e.g., survival training or mission scenarios in a Multi Mission Trainer (MMT); and (6) Full ground mission task where the pilot uses a Full Mission Simulator (FMS) or a Dynamic Flight Simulator (DFS). Some parts of the Superagility Training Structure have not been a scope in this chapter. They are therefore briefly mentioned here.
Author
Training Devices; Pilot Training; Pilot Selection; Physiological Factors

20010056525 Ponomarenko (V.), Moscow, Russia

Psychophysiological Problems of Modern and Future Aviation, Appendix C

Ponomarenko, V., Ponomarenko (V.), Russia; Human Consequences of Agile Aircraft; May 2001, pp. 149-154; In English; See also 20010056513; Copyright Waived; Avail: CASI; A02, Hardcopy

Aviation medicine keeps under observation, explores, and studies human beings on the verge of their capabilities in a hostile environment, where they display not only spiritual greatness and corporal strength, but disintegration of whole somatic systems. Psychophysiology shapes and changes the qualities of the organism and personality, his physical, psychological, ethical, and moral sources, which dictates that the pilot be fitted to flying activity in 20-25 years and to reach his peak during 20-25 years of life. Naturally, aviation medicine is involved in the course of aviation technologies research and development, technical learning devices, means and methods of psychophysiological training, formation of methods for health protection, maintenance of high performance, and effectiveness and prolongation of flying longevity. It follows that aviation medicine, in contrast to more technical disciplines, appears to be an integral one because this branch ensures human factors in all diversity of interactions with machines, control, communication, training, learning. The quintessence of the practical side of this science comes to flying safety problems solutions. This task may be solved at two levels: subject-functional and system-purposeful. The subject-functional level is limited by traditional medico-hygienic problems of human life support systems in aircraft cockpits. The system-purposeful level presupposes the investigations based on human performance principle with consideration of pilot-aircraft system interaction in the process of professional tasks fulfillment.

Derived from text

Aerospace Medicine; Human Factors Engineering; Psychophysiology

54
MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

Includes human factors engineering; bionics, man-machine, life support, space suits and protective clothing. For related information see also 16 Space Transportation and 52 Aerospace Medicine..

20010054773 Research and Technology Organization, Human Factors and Medicine Panel, Neuilly-sur-Seine, France

The Requirements for an Emergency Breathing System (EBS) in Over-Water Helicopter and Fixed Wing Aircraft Operations ***Specification d'un Respirateur de Sauvetage Pour Aeronefs a Voilure Fixe et a Voilure Tournante en Mission de Survol Maritime***

Brooks, Chris J., Survival Systems Ltd., Canada; Tipton, Mike J., Portsmouth Univ., UK; May 2001; 92p; In English; CD-ROM contains full text document in pdf format

Report No.(s): RTO-AG-341; AC/323(HFM-054)TP/22; ISBN 92-837-1058-4; Copyright Waived; Avail: CASI; A05, Hardcopy; A01, Microfiche; C01, CD-ROM

This AGARDograph provides the latest worldwide statistics on survivability from a helicopter ditching. It concludes that the persistent 15% fatality rate is basically caused by drowning. The principal cause of drowning is due to inability to breath-hold long enough to make an escape. The provision of some form of Emergency Breathing System (EBS), whether a re-breather or compressed air unit, would extend the time underwater and hence improve survivability. The development of such units since the Second World War are described, and current available units are included to aid NATO and PfP Nations to review their choice. The importance of producing a course training package prior to the introduction of any new EBS into service is presented. Two examples are specifically cited. Finally, a summary is made of the current EBS situation as we enter into the 21st Century.

Author

Underwater Breathing Apparatus; Life Support Systems; Survival Equipment; Escape (Abandonment)

20010055588 NASA Dryden Flight Research Center, Edwards, CA USA

Flight Demonstration of X-33 Vehicle Health Management System Components on the F/A-18 Systems Research Aircraft

Schweikhard, Keith A., NASA Dryden Flight Research Center, USA; Richards, W. Lance, NASA Dryden Flight Research Center, USA; Theisen, John, Sparta, Inc., USA; Mouyos, William, Sanders Lockheed Martin Co., USA; Garbos, Raymond, Sanders Lockheed Martin Co., USA; [1998]; 11p; In English; AIAA Digital Avionics Systems Conference, 7-13 Oct. 2000, Philadelphia, PA, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The X-33 reusable launch vehicle demonstrator has identified the need to implement a vehicle health monitoring system that can acquire data that monitors system health and performance. Sanders, a Lockheed Martin Company, has designed and developed a commercial off-the-shelf (COTS)-based open architecture system that implements a number of technologies that have not been

previously used in a flight environment. NASA Dryden Flight Research Center and Sanders teamed to demonstrate that the distributed remote health nodes, fiber optic distributed strain sensor, and fiber distributed data interface communications components of the X-33 vehicle health management (VHM) system could be successfully integrated and flown on a NASA F-18 aircraft. This paper briefly describes components of X-33 VHM architecture flown at Dryden and summarizes the integration and flight demonstration of these X-33 VHM components. Finally, it presents early results from the integration and flight efforts.
Author
Flight Tests; Structural Design; Systems Health Monitoring

20010056267 Aeronautical Systems Div., Crew Station Evaluation Facility, Wright-Patterson AFB, OH USA
A Human Factors Study of a Helmet Mounted Display for the Pilots of the B-1B ***Final Report, 1 Mar. - 30 Sep. 2000***
Provost, Scott; Kalman, William G.; Gable, Beverly A.; Sep. 2000; 57p; In English
Report No.(s): AD-A388598; ASC-TR-2000-5012; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

The objective of this study was to conduct a human factors evaluation of a conceptual Helmet Mounted Display (HMD) compared to Head Down displays (HDDs) in the JDAM/LAR environment, ten B-1B pilots flew 120 3 minute missions, with 4 display conditions, and 3 route conditions. The displays were a HMD, a 4”x 4” LCD, a 8”x6” LCD and the B-1B Block displays (in order). Recommendations were made for improving the HMD.
DTIC
Helmet Mounted Displays; Human Factors Engineering; B-1 Aircraft; Pilots (Personnel)

20010056302 Research and Technology Organization, Human Factors and Medicine Panel, Neuilly-sur-Seine, France
NATO Guidelines on Human Engineering Testing and Evaluation ***Final Report Directives OTAN en Matiere d’Essais et d’Evaluations Ergonomiques***
May 2001; 108p; In English; CD-ROM contains full text document in PDF format
Report No.(s): RTO-TR-021; AC/323(HFM-018)TP/19; ISBN 92-837-1068-1; Copyright Waived; Avail: CASI; C01, CD-ROM; A06, Hardcopy; A02, Microfiche

Testing and Evaluation (T&E) is an integral part of the system development process. Human Engineering T&E addresses the quality and effectiveness of the interface between the humans who participate as part of a human-machine system and the hardware and other non-human components. In the interest of supporting among NATO nations the co-development, co-production of systems, and shared use of T&E resources as a means of sharing more effective and less expensive systems, this document describes techniques and methods that are recommended for common use in NATO. The measurement categories addressed are: (1) Description of test participants; (2) Measurement of operator workload; (3) Human task performance measurement; (4) User opinion; and (5) Engineering measurement of hardware characteristics. It is recommended that the techniques and methods described be used to the maximum extent possible, and that the list be revised periodically to support currency and continued usefulness.
Author
Human Factors Engineering; Human Performance; Human-Computer Interface; Evaluation

20010056394 NASA Ames Research Center, Moffett Field, CA USA
Method and Apparatus for Monitoring of Daily Activity in Terms of Ground Reaction Forces
Whalen, Robert T., Inventor, NASA Ames Research Center, USA; Breit, Gregory A., Inventor, NASA Ames Research Center, USA; Feb. 06, 2001; 21p; In English
Patent Info.: Filed 13 Oct. 1995; NASA-Case-ARC-14063-1; US-Patent-6,183,425; US-Patent-Appl-SN-540614; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A device to record and analyze habitual daily activity in terms of the history of gait-related musculoskeletal loading is disclosed. The device consists of a pressure-sensing insole placed into the shoe or embedded in a shoe sole, which detects contact of the foot with the ground. The sensor is coupled to a portable battery-powered digital data logger clipped to the shoe or worn around the ankle or waist. During the course of normal daily activity, the system maintains a record of time-of-occurrence of all non-spurious foot-down and lift-off events. Off line, these data are filtered and converted to a history of foot-ground contact times, from which measures of cumulative musculoskeletal loading, average walking- and running-specific gait speed, total time spent walking and running, total number of walking steps and running steps, and total gait-related energy expenditure are estimated from empirical regressions of various gait parameters to the contact time reciprocal. Data are available as cumulative values or as daily

averages by menu selection. The data provided by this device are useful for assessment of musculoskeletal and cardiovascular health and risk factors associated with habitual patterns of daily activity.
Official Gazette of the U.S. Patent and Trademark Office
Walking; Running; Recording Instruments; Monitors

20010056513 Research and Technology Organization, Human Factors and Medicine Panel, Neuilly-sur-Seine, France
Human Consequences of Agile Aircraft ***Facteurs Humains Lies au Pilotage des Avions de Combat Tres Manoeuvrants***
May 2001; 186p; In English, 15-17 Apr. 1997, Istres AFB, Nellis AFB, NV, Linkoping, Manching, Edwards AFB, CA, Wright-Patterson AFB, OH, France, USA, Sweden, Germany, USA, USA; See also 20010056514 through 20010056525; CD-ROM contains full text document in PDF format
Report No.(s): RTO-TR-015; AC/323(HFM-015)TP/15; ISBN 92-837-1065-7; Copyright Waived; Avail: CASI; C01, CD-ROM; A09, Hardcopy; A02, Microfiche

While historically agile flight was first seen as an issue of airframe agility with a consequent emphasis on acceleration issues, there has been an evolution in the understanding of agility. WG 27 adopted WG 19's recommendations that airframe agility is only one aspect of agility which when combined with weapons agility and systems agility results in operational agility. The experienced pilots that we interviewed saw a real operational need for agile aircraft. They consistently rated both high angle-of-attack/nose pointing and off-boresight missiles/helmet-mounted display/sight systems as very important capabilities. They denied physiologic problems related to acceleration or spatial disorientation, although their sorties to date have been with a clear sky, in active control. Experts predict an increase in both G-LOC and spatial disorientation mishaps in future agile aircraft. In particular, there are significant gaps in our understanding of the effects of multi-axis accelerations. With minimal constraints on angle-of-attack and expanded weapon launch envelopes, novel displays will be required that enable pilots to fly with references well beyond conventional fields-of-view. Intelligent interfaces, and automated subsystems will be required to help pilots cope with the tactical situation, while also maintaining situational awareness. Efficient controls are also needed to enable pilots to command and operate equipment quickly and accurately. The thrust-vectoring and post-stall operations should be fully integrated into the flight control system. Pilots still prefer controlling aircraft functions via HOTAS (hands-on-throttle-and-stick) although voice and gaze-based control may also be useful. Current pilot protection systems will be inadequate in an unconstrained flight envelope and during ejection. Both basic and applied research will be needed to ensure that the potential benefits of increased agility are realized.
Author
Aerodynamic Characteristics; Maneuverability; Thrust Vector Control; Pilots (Personnel); Flight Control; Human Factors Engineering; Highly Maneuverable Aircraft; Conferences

20010056514 Biodynamic Research Corp., San Antonio, TX USA
Introduction
Banks, R. D., Biodynamic Research Corp., USA; Lyons, T. J., Asian Office of Aerospace Research and Development, Japan; Firth, J., Queens Medical Centre, UK; Human Consequences of Agile Aircraft; May 2001, pp. 1-9; In English; See also 20010056513; Copyright Waived; Avail: CASI; A02, Hardcopy

Benjamin Gal-Or has been one of the leading proponents of high-agility propulsion. Many of his ideas, and those of his contemporary Wolfgang Herbst, are visionary, futuristic, and controversial. In a relatively short period of time, these men, and others, have influenced the direction of fighter aircraft design. 'High-agility' aircraft are now being tested and flown operationally. This new technology will offer new challenges, and threats, to human operators. Solving the inevitable human factors problems that will emerge will involve questioning established doctrine, and reaching for innovative and imaginative solutions. The 'inherent time-lag' referred to by Gal-Or could apply equally to the time-lag that now exists between the evolution of high-agility flight capability and current human protective/performance technology. There currently exists a technology gap, the precise nature of which is only partly understood. Typically, human factors are considered only after concept, design, and aircraft prototype development, and often after loss of life. Some human factors problems, identified years ago, have never been completely solved. Failure to identify the inevitably unique problems that will attend human exposure to the high-agility flight environment will unquestionably lead to needless loss of life and scarce resources. High-agility flight will challenge every aspect of human protection and performance. Many old engineering designs and assumptions will be challenged. During the narrow window of opportunity that now exists between concept, test, and widespread operational deployment of high-agility aircraft such as the F-22 and JSF, aggressive research aimed at exploring the problems and solutions will enhance the value of the these weapons, and prevent needless loss of life.
Author
Aircraft Design; Human Factors Engineering; Highly Maneuverable Aircraft

20010056515 Institut de Medicine Aerospatiale Armee, Bretigny sur Orge, France

”Operational Need” and ”Situational Awareness” Survey

Grau, J. Y., Institut de Medicine Aerospatiale Armee, France; Lyons, T. J., Asian Office of Aerospace Research and Development, Japan; Human Consequences of Agile Aircraft; May 2001, pp. 11-19; In English; See also 20010056513; Copyright Waived; Avail: CASI; A02, Hardcopy

Determining the human consequences on crews of flying agile aircraft is not an easy task, because of the lack of operational feedback regarding missions performed with these aircraft. A way to envisage potential human consequences is to transfer the experience acquired on agile aircraft prototypes and on last generation combat aircraft to the operational situations these future agile aircraft are expected to meet. to this end, the Working Group #27 carried out a survey with pilots of last generation combat aircraft flying in the Air Forces represented in the working group. In order to envisage the different fields of potential human consequences, the Working Group #27 led two actions between April 1997 and October 1998: first, interviews conducted with experienced military fighter pilots and test pilots concerning the operational need and consequences of agile aircraft flight on physiology and pilot-vehicle issues; second, questionnaire survey developed to address psychological consequences of agile aircraft flights and its consequences on situational awareness and mission performance.

Author

Highly Maneuverable Aircraft; Human Factors Engineering; Human Performance

20010056516 Office National d’Etudes et de Recherches Aerospatiales, Systems Control and Flight Dynamics Dept., Salon Air, France

Agility: Definitions Basic Concepts and History

LeBlaye, Patrick, Office National d’Etudes et de Recherches Aerospatiales, France; Human Consequences of Agile Aircraft; May 2001, pp. 21-38; In English; See also 20010056513; Original contains color illustrations; Copyright Waived; Avail: CASI; A03, Hardcopy

The purpose of this presentation is to provide some engineering basis of the concept of agility. The definition of agility has evolved across recent aviation history, from the well known area of airframe agility to a global concept of operational agility. Some historical definitions are given and the underlying concepts are explained. The working group 27 has adopted the consensus definitions initially proposed by the working group 19 of the Flight Mechanics Panel of AGARD, in order to support its discussion on the Human consequences of aircraft agility. The concept of agility can be applied to each component of the combat system (airframe, systems, weapons). Agility factors specific to each component are briefly examined, and some orders of magnitude are given, concerning present and future weapon systems performances, which may have particular consequences on the human in flight. The concept of operational agility is introduced; this concept integrates the role of the human pilot. This paper is concluded with some perspectives for potential areas of preoccupation relative to human implications of the future combat scenarios and information environment.

Author

Highly Maneuverable Aircraft; Aeronautical Engineering; Pilot Performance

20010056519 Air Force Research Lab., Wright-Patterson AFB, OH USA

Pilot-Vehicle Interface

Calhoun, G., Air Force Research Lab., USA; LeBlaye, P., Office National d’Etudes et de Recherches Aerospatiales, France; Welsch, H., Institute of Aviation Medicine, Germany; Human Consequences of Agile Aircraft; May 2001, pp. 59-97; In English; See also 20010056513; Copyright Waived; Avail: CASI; A03, Hardcopy

The steady development and integration of advances in aerodynamics, flight control, propulsion, materials, equipment, structures, and avionics promise to make agile aircraft a reality. Through these developments, exciting new capabilities in agile airframes, agile weapons, and agile systems will be available to pilots. However, the ergonomic design of the pilot-vehicle interface (PVI) for agile aircraft poses a more difficult challenge, compared to designing earlier high performance aircraft. For instance, the high angular rates, accelerations, and onset rates of agile airframes place heavy demands on pilots and life support systems. If these fail, ejection from an unconstrained flight envelope makes additional demands on egress systems. With minimal constraints on angle-of-attack and expanded weapon launch envelopes, novel display formats will be required that enable pilots to fly with references well beyond conventional fields-of-view. Improvements in aircraft dynamics and weapons capabilities have also led to a dramatic increase in the tempo of the tactical situation. This, in turn, reduces the pilot’s available processing and decision time. Decision aids and automated subsystems are required to help pilots cope with these increasing demands, while also maintaining situational awareness (SA). Recent advancements in sensor and off board information technology have resulted in an explosion in the complexity and sheer quantity of information that potentially can be displayed to the pilot. Efficient displays, utilizing these technologies, are needed to provide pilots with the ’right data, in the right place, at the right time.’ Efficient controls

are also needed to enable pilots to command and operate equipment quickly and accurately. In sum, agile aircraft, in terms of airframe, weapons, and systems, introduce new requirements and performance standards for crew station design.
Derived from text
Pilot Performance; Decision Making; Decision Support Systems; Human-Computer Interface

20010056523 Asian Office of Aerospace Research and Development, Tokyo, Japan
Conclusions
Lyons, T. J., Asian Office of Aerospace Research and Development, Japan; Human Consequences of Agile Aircraft; May 2001, pp. 131-136; In English; See also 20010056513; Copyright Waived; Avail: CASI; A02, Hardcopy

While historically the issue of agile flight was first seen as an issue of airframe agility with a consequent emphasis on acceleration issues, there has been an evolution in the understanding of agility. Working Group (WG) 27 adopted the recommendations from WG 19, that aircraft agility is only one aspect of agility which when combined with weapons agility and systems agility results in 'operational agility.' Increases in agility of each of these components will result in increased Global Agility which will result in an increased information flow being made available to the pilot. This increased information flow will need to be efficiently utilized in order to maximize operational agility and mission effectiveness.
Author
System Effectiveness; Highly Maneuverable Aircraft

20010056524 Ponomarenko (V.), Moscow, Russia
High-Speed Flight as a System of Medical-Psychological Support of Domination in the Air, Appendix B
Ponomarenko, V., Ponomarenko (V.), Russia; Human Consequences of Agile Aircraft; May 2001, pp. 141-148; In English; See also 20010056513; Copyright Waived; Avail: CASI; A02, Hardcopy

It is pilot's activity under unnatural environmental conditions which serves as an impetus for understanding the sources of man's essential strength, regularities of the ultimate sense of a pilot's needs in mastering the universe. Is this a source of spiritual strength? Here is a question for airspace medicine: Airspace medicine, as its name implies, deals with what takes place far beyond the horizon, as its object is not only the functioning of an organism under extreme biophysical conditions but the subject as a sky inhabitant as well. A pilot as a sky inhabitant exists in a different world of values. In particular, he perceives a high-speed flight, above all, as an instrument for achieving the main result, namely, superiority in dual situations. Speed is a maneuver, tactics which is transformed by intellect into a successful achievement of the final result. Th speed of the flight is always experienced as passion. These seemingly irrelevant speculations are directly related to the safety of high-speed flight. The point is that in a maneuvering air battle a pilot is not so much afraid of losing consciousness as his prestige, his professional ego. It is this purposefulness and not fear that draws him back to a zone of realized extended risk.
Derived from text
Pilot Performance; Psychological Factors; Risk

20010057601 Defence Science and Technology Organisation, Air Operations Div., Fishermans Bend, Australia
Size Estimation With Night Vision Goggles
Zalevski, Anna, Defence Science and Technology Organisation, Australia; Meehan, James W., Defence Science and Technology Organisation, Australia; Hughes, Philip K., Defence Science and Technology Organisation, Australia; February 2001; 38p; In English
Report No.(s): DSTO-RR-0201; AR-011-775; Copyright; Avail: Issuing Activity

Human observers matched the size of a comparison disc object to the perceived size of a test disc located at between 1 and 6 m under normal daylight viewing and when viewing through night vision goggles (NVGs) under simulated starlight. The results showed that observers were more accurate at judging size with unaided vision than when viewing with NVGs. The results for unaided viewing were in accord with the law of size constancy that predicts that accurate size estimation is a result of observers taking into account the distance at which objects are located. The results for viewing with NVGs depart from size constancy and are influenced to a greater extent by the law of visual angle that predicts that size estimates are based more on the angular size of the target because there is inadequate distance information available in this condition. These results demonstrate that NVGs alter normal visual space perception and this should be taken into account in training aircrew and evaluating the effect of NVGs on flying performance. Our results are consistent with other results reported in the literature for longer observation distances.
Author
Night Vision; Flight Crews; Visual Perception; Goggles

20010057611 National Inst. for Occupational Safety and Health, Rockville, MD USA

National Occupational Research Agenda for Musculoskeletal Disorders: Research Topics for the Next Decade. A Report by the NORA Musculoskeletal Disorders Team

Jan. 2001; 46p; In English

Report No.(s): PB2001-105387; DHHS/PUB/NIOSH-2001-117; No Copyright; Avail: CASI; A01, Microfiche; A03, Hardcopy

Work-related musculoskeletal disorders (MSD), such as low back pain, tendinitis, hand-arm vibration syndrome and carpal tunnel syndrome, account for a major component of the cost of work-related illness in the USA. Recent estimates of the costs associated with work-related musculoskeletal disorders range from $13 to $54 billion annually. Regardless of the estimate used, the problem is large both in health and economic terms. The enormous scope of the problem is confirmed by the Bureau of Labor Statistics (BLS). For those cases involving days away from work, BLS reports that in 1997 approximately one third of the total, or 603,096 cases, were the result of overexertion or repetitive motion.

NTIS

Musculoskeletal System; Signs and Symptoms

20010058955 Research and Technology Organization, Human Factors and Medicine Panel, Neuilly-sur-Seine, France

Soldier Mobility: Innovations in Load Carriage System Design and Evaluation ***la Mobilite du Combattant: Innovations dans la Conception et l'Evaluation des Gilets d'Intervention***

Soldier Mobility : Innovations in Load Carriage System Design and Evaluation; May 2001; 280p; In English, 27-29 Jun. 2000, Kingston, Canada; See also 20010058956 through 20010058977; CD-ROM contains full text document in PDF format

Report No.(s): RTO-MP-056; AC/323(HFM-043)TP/28; ISBN 92-837-1062-2; Copyright Waived; Avail: CASI; C01, CD-ROM; A13, Hardcopy; A03, Microfiche

On 27-29 June 2000, NATO, Partners for Peace and Non-NATO nationals from 10 countries met in Kingston, Canada to discuss soldier mobility through innovations in load carriage system design and evaluation. Sponsored by the Human Factors and Medicine Panel (HFM) of the North Atlantic Treaty Organization's Research and Technology Organization, the specialist's meeting participants examined the current state of knowledge in load carriage, exchanged findings from recent research and development initiatives, explored what initiatives were needed to develop new concepts in design and evaluation and identified opportunities for collaboration. Specific sessions were held on the physiology, biomechanics and performance measures of load carriage, approaches and tools for assessment, development and validation of objective tests and their use in design solutions, mathematical modelling and the accuracy of pressure sensor measurement systems. There were two keynote addresses, twenty-five scientific papers, four workshops on future directions and tours of load carriage research facilities during the conference. The meeting unveiled many new findings, such as: possible energy transfers between body segments and between the pack and the person; objective assessment technologies for better understanding and design of load carriage systems; an interest in mathematically modelling the pack-person interactions and their effects on the carrier; and a willingness to work together toward sharing resources, data and the development of an improved STANAG for personal load carriage.

Author

Biodynamics; Conferences; Human Factors Engineering; Human Performance; Weight (Mass)

20010058956 Aeromedical Inst., Soesterberg, Netherlands

Physiological Strain During Load Carrying: Effects of Mass and Type of Backpack

Holewijn, Michael, Aeromedical Inst., Netherlands; Meeuwsen, Ted, Aeromedical Inst., Netherlands; Soldier Mobility : Innovations in Load Carriage System Design and Evaluation; May 2001, pp. 1-1 - 1-12; In English; See also 20010058955; Copyright Waived; Avail: CASI; A03, Hardcopy

The effects of mass (0, 5.4, 10.4 kg) and the type of support (on the shoulder or on waist) on physiological and mechanical strain indices of four young male subjects were quantified. While standing, oxygen uptake was not influenced by the type or mass of the backpack, and averaged 10% maximal oxygen uptake. The heart rate increased significantly by 9 beats per min while standing wearing a backpack. While walking (1.33 m/s) the mass significantly influenced both the heart rate and the oxygen uptake carried, but both types of strain remained below the tolerance limits for prolonged wear. Standing supporting a load did not significantly increase the electromyographic (EMG) signal of the trapezius shoulder muscle (pars descenders). While walking, load carrying significantly increased the EMG of the shoulder muscles. The pressure on the skin under the shoulder straps during load carrying on the shoulders was more than a factor of three times higher than the threshold value for skin and tissue irritation. Load transfer to the waist with a flexible frame reduced the pressures on the skin of the shoulder to far below the threshold value.

On basis of these results it was concluded that even with relatively low loads the limiting factor was the pressure on the skin, if a waist belt did not relieve such pressure on the shoulders.
Author
Physiology; Shoulders; Walking; Weight (Mass); Stress (Physiology); Muscular Fatigue; Human Performance

20010058957 Army Research Inst. of Environmental Medicine, Military Performance Div., Natick, MA USA
Correlates of Load Carriage Performance Among Women
Pandorf, Clay E., Army Research Inst. of Environmental Medicine, USA; Harman, Everett A., Army Research Inst. of Environmental Medicine, USA; Frykman, Peter N., Army Research Inst. of Environmental Medicine, USA; Patton, John F., Army Research Inst. of Environmental Medicine, USA; Mello, Robert P., Army Research Inst. of Environmental Medicine, USA; Nindl, Bradley C., Army Research Inst. of Environmental Medicine, USA; Soldier Mobility : Innovations in Load Carriage System Design and Evaluation; May 2001, pp. 2-1 - 2-9; In English; See also 20010058955; Copyright Waived; Avail: CASI; A02, Hardcopy

To examine correlates of the speed at which female soldiers carrying loads could cover ground on foot, 12 volunteers (mean+/-SD: 25.316 years, 166+/-7 cm, 61.3+/-7 kg) were timed over 3.2 km while carrying loads of 14, 27, and 41 kg. Respective course times were 25.7+/-3, 30.7+/-4 and 36.9+/-5 min, which differed significantly (pis less than 0.05) from each other. A correlation analysis with independent variables of body mass, bitrochanteric diameter, hip circumference, shoulder diameter, height, age, relative Maximal oxygen uptake (VO2(sub max)), (ml/kg/min), absolute VO2(sub max) (1/min), percent body fat, fat free mass, and self-reported scores on the Army fitness test (pushups, situps and 3.2 km run) revealed that absolute VO2(sub max) max and 3.2 kin run time were the best predictors of loaded 3.2 km run time for each load. Correlation coefficients for the 14, 27 and 41 kg load course times respectively were -0.64, -0.61 and -0.70 for absolute VO2(sub max) and 0.80, 0.67 and 0.75 for the 3.2 km run time. For the 14 and 27 kg loads there were no anthropometric measurements that correlated well with run time. However, with the 41 kg load, there were good relationships (pis less than 0.1) between 3.2 km run time and body mass (r=-0.59), height (r=-0.55), hip circumference (r=-0.52) and fat free mass as determined from skin folds (r=-0.56). This suggests that larger subjects with greater muscle mass, for whom the 41 kg load represented a smaller percentage of their bodyweight, were able to carry the heaviest load faster than smaller, less muscular subjects.
Author
Anthropometry; Females; Muscles; Physical Exercise; Weight (Mass); Human Performance

20010058958 Centre de Recherches du Service de Sante des Armees, Unite de Bioenergetique, Clamart, France
A Combination of Biomechanical and Physiological Approaches for Determination of Optimal Load Distribution
Bigard, A. X., Centre de Recherches du Service de Sante des Armees, France; Soldier Mobility : Innovations in Load Carriage System Design and Evaluation; May 2001, pp. 3-1 - 3-7; In English; See also 20010058955; Copyright Waived; Avail: CASI; A02, Hardcopy

France is developing an integrated soldier ensemble that will improve soldier protection, survivability and sustainability. Improvement of the soldier's load carrying capacity remains an important step that will contribute to the maintenance of good health and protection against the side effects induced by soldier systems. A number of factors can influence the energy cost associated with locomotion. The aim of many studies has been to determine the level of oxygen uptake that can be maintained without physical fatigue. A myriad of kinematic and kinetic parameters may directly or indirectly influence the energy cost of locomotion, especially when subjects are walking with loaded backpacks. While the metabolic energy cost of human movement is easy to estimate by the global measure of total body oxygen consumption (VO2), a variety of computational techniques have been suggested as appropriate for the calculation of mechanical power. The changes in energy of the centre of mass (via ground reaction forces) have been frequently used to estimate the mechanical power of locomotion. One limitation of these measures is that they do not include the work done in moving the limbs and arms. This work, often termed "internal work", is one essential component of total mechanical work associated with locomotion. Because measures of mechanical power which do not include contributions from all of the internal and external work done may provide misleading information, recent methods involving a segmental analysis have been suggested to determine the changes in the energy of individual body segments. Thus, measures of both oxygen consumption during walking and load carriage, and mechanical work are two essential steps in the assessment of the relationship of physiological energy expenditure to mechanical factors. Our approach to the study of human movement efficiency involves determination of the mechanical efficiency of human locomotion with backpack loads simultaneously with measurement of biochemical, cardiovascular, muscular and mechanical responses that occur during treadmill walking. In the framework of the development of the French soldier system, the first step of our program is to determine the optimal distribution

and placement of the load by examining the changes in mechanical work, muscular activity and energy cost of walking on a treadmill.
Author
Biodynamics; Physiological Responses; Walking; Human Performance; Weight (Mass); Mass Distribution

20010058959 Dalhousie Univ., School of Health and Human Performance, Halifax, Nova Scotia Canada
The Effect of Load Position on Biomechanical and Physiological Measures During a Short Duration March
Johnson, R. C., Dalhousie Univ., Canada; Pelot, R. P., Dalhousie Univ., Canada; Doan, J. B., Queens Univ., Canada; Stevenson, J. M., Queens Univ., Canada; Soldier Mobility: Innovations in Load Carriage System Design and Evaluation; May 2001, pp. 4-1 - 4-6; In English; See also 20010058955; Copyright Waived; Avail: CASI; A02, Hardcopy

This project attempted to determine the physiological and biomechanical effects of varying the centre of gravity of a load in a backpack in a short duration activity. Experienced soldiers (n=22) carried a 36.0 kg modified US Army ALICE backpack on a treadmill at 5.6 km/h for 15 minutes at 0' elevation. The subjects carried the load in three locations in a backpack (a high, middle and low distribution) and employed a load carriage vest as an 'alternative' distribution. This 'alternative' distribution balanced the load on the front and back of the subject. Oxygen consumption results showed no statistically significant difference between load locations (P = 0.621). Biomechanical analysis of the trunk lean and minimum included hip angles indicated significant differences between all 'alternative' comparisons as well as between the low and high load locations (Pis less than 0.05). Maximum knee flexion angles were also shown to be significantly different between the low and alternate conditions. Cadence, stride length and displacement of the body Center of Gravity (COG) did not show significant differences between conditions. Subjective evaluation indicated a strong preference for the alternative load condition due to the overall increased mobility and decreased feeling of discomfort. Under the conditions tested in this study it was concluded that load location does not significantly affect oxygen consumption but had a large impact on the perception of each load trial. A longer duration activity that imposes a larger strain on the subjects would be required to confirm this oxygen cost finding. The effect that trunk lean and the flexion angles will have on fatigue and energy consumption in a long-term exercise scenario has not been determined but should be undertaken in future studies. The subjective impact on the subjects should be considered as highly important and should therefore have an impact on the future design of load carriage systems.
Author
Biodynamics; Center of Gravity; Mobility; Physical Exercise; Physiological Effects; Position (Location); Exercise Physiology

20010058960 Army Research Inst. of Environmental Medicine, Natick, MA USA
Load-Speed Interaction Effects on the Biomechanics of Backpack Load Carriage
Haran, Everett, Army Research Inst. of Environmental Medicine, USA; Han, Ki-Hoon, Army Research Inst. of Environmental Medicine, USA; Frykman, Peter, Army Research Inst. of Environmental Medicine, USA; Soldier Mobility: Innovations in Load Carriage System Design and Evaluation; May 2001, pp. 5-1 - 5-16; In English; See also 20010058955; Copyright Waived; Avail: CASI; A03, Hardcopy

We biomechanically examined how backpack load and walking speed interact in their effects. 16 males walked under all 12 combinations of 6, 20, 33, and 47 kg backpack loads and 1.17, 1.33, and 1.50 m/s walking speeds. Generally, the effects of load were consistent over the speeds, and the effects of speed were consistent over the loads. Ground reaction forces and impulses, joint forces, muscle torques, muscle electrical activity and back-pack acceleration increased when speed and/or load increased. likely increasing the probability of fatigue and injury. As load increased, percentage of stride in double-support and time of toe-off increased, and maximum hip angle decreased, likely improving stability and reducing stress on the musculoskeletal system. However, increases in walking speed tended to cancel these adaptations. At the lower speeds but not the highest one, stride frequency increased and stride time decreased when the load increased from 33 to 47 kg. Downward impulses for the major lower body joints increased with load carried, but decreased as walking speed increased. At the 1.33 m/s speed, but not at 1.50 m/s, a gait adaptation resulted in a less-than-expected impulse increase when the load increased from 33 kg to 47 kg. At the fastest walking speed, the volunteers could not further increase stride frequency to reduce stride length, increase stability, and reduce potential lower body stresses. Thus, it appears that soldiers should avoid, if possible, walking faster than 1.33 m/s (4.8 km/hr; 3.0 mi/hr) when carrying backpack loads approaching 47 kg (100 lb).
Author
Males; Muscular Function; Walking; Weight (Mass); Human Performance; Exercise Physiology; Physiological Effects; Physical Exercise

20010058961 Army Research Inst. of Environmental Medicine, Military Performance Div., Natick, MA USA

The Effect of Load Carriage on Trunk Coordination During Treadmill Walking at Increasing Walking Speed

LaFiandra, Michael, Army Research Inst. of Environmental Medicine, USA; Obusek, John P., Army Research Inst. of Environmental Medicine, USA; Holt, Kenneth G., Boston Univ., USA; Wagenaar, Robert, Boston Univ., USA; Soldier Mobility: Innovations in Load Carriage System Design and Evaluation; May 2001, pp. 6-1 - 6-7; In English; See also 20010058955; Original contains color illustrations; Copyright Waived; Avail: CASI; A02, Hardcopy

The purpose of this experiment was to determine the effects of walking speed and wearing a backpack on trunk coordination and upper and lower body angular momentum. Twelve subjects (5 male, 7 female, mean age, yr: mean+/-SD = 26+/-7.1) walked on a treadmill at increasing speeds from 0.6 m/s to 1.6 m/s in 0.2 m/s increments. Subjects walked with a backpack (BP) containing 40% of their body mass and with no backpack (NBP). Peak pelvic and thoracic angular velocities were measured, and peak upper body and lower body angular momentum and the relative phase between the pelvis and thorax were calculated. A Repeated Measures ANOVA with two within-subject factors (load and speed) was used to compare the dependent variables. A significant main effect of BP condition was found in pelvic (p is less than 0.000 1) and thoracic (p is less than 0.0001) angular velocities, upper (p is less than 0.0003) and lower (p is less than 0.0001) body angular momentum, and relative phase (p is less than 0.0014). In addition, a significant main effect of walking speed was found in thoracic angular velocity (p is less than 0.0001), pelvic angular velocity (p is less than 0.0001), upper body angular momentum (p is less than 0.0001), lower body angular momentum (p is less than 0.0001), and relative phase (p is less than 0.0001). A significant interaction effect between speed and load was determined for thoracic angular velocity (p is less than 0.0001), upper body angular momentum (p is less than 0.0006), and relative phase (p is less than 0.0001). There were higher pelvic and thoracic angular velocities, and higher upper and lower body angular momentum in the NBP condition compared to the BP condition. In the NBP condition, relative phase between pelvic and thoracic rotation increased from 54 degrees at .6 m/s to 122 degrees at 1.6 m/s. In contrast, the increase in relative phase in the BP condition was less, from 48 degrees at .6 m/s to 78 degrees at 1.6 m/s. With the addition of the BP, the decrease in thoracic angular velocity observed was disproportionate to the increase in the moment of inertia of the upper body caused by the addition of the pack, resulting in lower upper body angular momentum compared to the NBP condition. The lower upper body angular momentum in the BP condition may have occurred as a means to reduce the muscular force required to rotate the thorax, and hence lowered the metabolic cost of the increased load.

Author

Angular Momentum; Angular Velocity; Walking; Physical Exercise; Exercise Physiology; Biodynamics; Weight (Mass)

20010058962 Army Natick Soldier Center, Supporting Science and Technology Directorate, Natick, MA USA

The Effects of Load Weight : A Summary Analysis of Maximal Performance, Physiological, and Biomechanical Results from Four Studies of Load-Carriage Systems

Polcyn, Amy Fronduti, Army Natick Soldier Center, USA; Bensel, Carolyn K., Army Natick Soldier Center, USA; Harman, Everett A., Army Research Inst. of Environmental Medicine, USA; Obusek, John P., Army Research Inst. of Environmental Medicine, USA; Soldier Mobility: Innovations in Load Carriage System Design and Evaluation; May 2001, pp. 7-1 - 7-11; In English; See also 20010058955; Original contains color illustrations; Copyright Waived; Avail: CASI; A03, Hardcopy

Data from studies of standard and prototype load-carriage equipment were analyzed to determine the effects of the weight borne by male and female load carriers on time to traverse a 3.2 km course at self-paced, maximal speed and on energy expenditure and kinetic and kinematic variables during externally paced walking at 4.8 km/h. The equipment configurations included fighting, approach, and sustainment loads, with masses varying from 12 kg to 50 kg. It was found that course completion times and energy expenditure were directly related to the weight carried. The effects of load weight on the kinematic and kinetic variables were more complex. They included evidence of adaptations in walking gait that are likely to aid the load carrier in maintaining stability and in absorbing the increased forces associated with increased load on the body.

Author

Biodynamics; Walking; Human Performance; Physical Exercise; Exercise Physiology; Weight (Mass); Body Kinematics; Kinetics

20010058963 Army Research Inst. of Environmental Medicine, Natick, MA USA

Correlates of Obstacle Course Performance Among Female Soldiers Carrying Two Different Loads

Frykman, P. N., Army Research Inst. of Environmental Medicine, USA; Harman, E. A., Army Research Inst. of Environmental Medicine, USA; Pandorf, C. E., Army Research Inst. of Environmental Medicine, USA; Soldier Mobility: Innovations in Load Carriage System Design and Evaluation; May 2001, pp. 9-1 - 9-9; In English; See also 20010058955; Copyright Waived; Avail: CASI; A02, Hardcopy

To examine correlates of obstacle course performance, 11 female volunteers (mean+/-SD: 25.3+/-5.5 yrs, 166+/-6.5 cm, 61.3+/-6.7 kg) negotiated an obstacle course (low hurdles, zigzag run, low crawl, overhead horizontal pipe, wall, and sprint) with a 14 kg fighting load and a 27 kg approach load. Predictive variables included Army physical fitness test (APFT: pushups, situps, and 3.2 km run) scores, treadmill VO2(sub max) and anthropometric variables. For the 14 kg load, pushups and situps correlated moderately (pis less than 01) with time to negotiate the low crawl and pipe. With the 27 kg load the APFT score correlated moderately with zigzag and low crawl times, body height correlated (pis less than 0.1) with hurdles and zigzag times, and VO2(sub max) correlated with zigzag and pipe performance. Only 55% of wall traversal attempts with the fighting load and 27% with the approach load were successful, and 80% of pipe traversal attempts with the fighting load and 30% with the approach load were successful. Because so many volunteers could not negotiate these stations, times for the segments were not included in the analysis of total course time. Pushups (r=-0.54, pis less than 0 1) and situps (r=-0.62, pis less than 0.1) best predicted course time with the 14 kg load, while the APFT score (r=-0.57, ris less than 0.1) best predicted time with the 27 kg load. Aerobic fitness and muscular endurance play important roles in obstacle course performance. As measures of these abilities, the total APFT score and its pushup and situp sub-scores can serve as field expedient predictors of obstacle course performance.
Author
Females; Performance Prediction; Physical Exercise; Physical Fitness; Weight (Mass)

20010058964 New York Univ., Dept. of Physical Therapy, New York, NY USA
The Influence of Load Carrying Methods on Gait of Healthy Women
Ling, Wen, New York Univ., USA; Axen, Kenneth, New York Univ., USA; Houston, Vern, Veterans Administration, USA; Soldier Mobility: Innovations in Load Carriage System Design and Evaluation; May 2001, pp. 10-1 - 10-6; In English; See also 20010058955; Copyright Waived; Avail: CASI; A02, Hardcopy

Various load configurations on healthy men, but not women, have been examined. Women were found to have higher incidence of musculoskeletal injuries when carrying a heavy load during basic training. The purpose of this study was to examine the changes in gait patterns of healthy women while carrying a 10 Kg. load on the back, around the waist, and across one shoulder. The investigators further evaluated the influence of shoulder muscle strength on their gait with three load carrying configurations. Nine healthy women without existing orthopedic problems in the spine and legs were recruited for this study, ranging in ages from 22 to 32 years, with a mean of 25.2. Their height ranged from 148 to 179 centimeters, with a mean of 161.8. Their weight ranged from 45 to 74.1 kilograms, with a mean of 57.7. Fourteen reflective markers were placed on the subjects' trunk and legs. Two videocameras were used to film the subject walking along a 10 meter walkway. Each subject was first required to walk at her self-selected speed without any load to establish a baseline and then, in random order, walk with a 10-Kg. load on the back, around the waist, and diagonally across one shoulder. The videotape was analyzed using the Ariel Performance Analysis System. Angles of trunk, shoulder, hip, knee, and ankle were calculated. Torque output of subject's shoulder flexors, extensors, abductors, adductors, horizontal abductors, and horizontal adductors were measured on a Biodex II isokinetic dynamometer. Each subject was required to complete three sets of concentric contraction at 150 degrees/second. The total work for three contractions was normalized to each subject's weight. Analyses of variance with repeated measures were used to examine the influence of load carrying methods on gait. Multiple regression analyses were conducted to evaluate the influence of shoulder girdle muscle strength. Results: Subjects walked with significantly different trunk and shoulder angles (pis less than 0.001) when walking with three load carrying configurations compared with the baseline and demonstrated the most rigid and flexed trunk when carrying the load on the back. Shoulder angles were significantly asymmetrical when carrying a load diagonally across one shoulder. There was no significant difference in hip, knee, and ankle angles. Shoulder girdle muscle strength strongly correlated with trunk and shoulder angles when carrying a load around the waist or on the back (r(exp 2)=0.855 to 0.989). Carrying a heavy load around the waist appeared to cause the least deviation from normal gait pattern for women. Women with strong shoulder muscles demonstrated less trunk and shoulder deviations when walking with a heavy load on the back.
Author
Females; Human Beings; Musculoskeletal System; Walking; Physical Exercise; Weight (Mass)

20010058965 Defence and Civil Inst. of Environmental Medicine, Toronto, Ontario Canada
Development of a Suite of Objective Biomechanical Measurement Tools for Personal Load Carriage System Assessment
Bossi, L. L., Defence and Civil Inst. of Environmental Medicine, Canada; Stevenson, J. M., Queens Univ., Canada; Bryant, J. T., Queens Univ., Canada; Pelot, R. P., Dalhousie Univ., Canada; Reid, S. A., Queens Univ., Canada; Morin, E. L., Queens Univ., Canada; Soldier Mobility: Innovations in Load Carriage System Design and Evaluation; May 2001, pp. 14-1 - 14-17; In English; See also 20010058955; Original contains color illustrations; Copyright Waived; Avail: CASI; A03, Hardcopy

The proper design of personal load carriage systems may be critical not only for soldier comfort, but also for soldier mobility and performance on the battlefield. Evaluation of soldier personal load carriage systems typically involves the conduct of

human-based lab and field trials that can be both time-consuming and costly to conduct. Field testing usually requires multiple system prototypes of a given design iteration, with their development cost often limiting the number of design iterations tested. Human-based trials also rely on subjective opinion for system assessment. While the opinions of the ultimate users have face validity, and bias and error can be controlled in such trials, it is also desirable to have objective load carriage assessment methods and analysis tools that pen-nit rapid analysis, design iteration and evaluation. Canada has developed biomechanical assessment and analytical tools to supplement human-based load carriage system assessment methods. This suite of tools permits efficient objective evaluation of important biomechanical aspects of load-bearing webbing, vests, packs and their components, thus contributing to early system assessment and a rapid iterative design process. This paper will introduce each of the assessment and analytical tools, their rationale, the objective measures available and the recommended performance criteria for acceptable military load carriage systems. Separate papers in these proceedings will provide the details of validation and utility of the tools that have been developed by Canada.
Author
Biodynamics; Mobility; Weight (Mass); Supports

20010058966 Queens Univ., School of Physical and Health Education, Kingston, Ontario Canada
Validation of Objective Based Measures and Development of a Performance-Based Ranking Method for Load Carriage Systems
Bryant, J. T., Queens Univ., Canada; Doan, J. B., Queens Univ., Canada; Stevenson, J. M., Queens Univ., Canada; Pelot, R. P., Queens Univ., Canada; Reid, S. A., Queens Univ., Canada; Soldier Mobility: Innovations in Load Carriage System Design and Evaluation; May 2001, pp. 15-1 - 15-12; In English; See also 20010058955; Original contains color illustrations; Copyright Waived; Avail: CASI; A03, Hardcopy

Standardized objective measurements for the evaluation of load carriage include the development of a load carriage simulator, a stiffness tester, and a suspension system characteristics tester. In addition, human-based methods have been developed by which the performance of load carriage systems undergoing evaluation in standardized military activities can be assessed. The purpose of this paper is to summarize three studies that examine the correlation between these objective and human-based measures. In the first study, face validation was undertaken by comparing the outcome of measurements made in pack-based systems using a simple biomechanical model. In the second study, a direct comparison of objective measures to human based measures in a cohort of military volunteers was undertaken. In a final study, a ranking method was explored as a way of characterizing military load carriage systems.
Author
Biodynamics; Supports; Weight (Mass); Human Performance

20010058967 Army Natick Soldier Center, Ergonomics Team, Natick, MA USA
Lessons Learned During the Development of the Modular Lightweight Load- Carrying Equipment (MOLLE) System
Sampson, James B., Army Natick Soldier Center, USA; Soldier Mobility: Innovations in Load Carriage System Design and Evaluation; May 2001, pp. 17-1 - 17-8; In English; See also 20010058955; Copyright Waived; Avail: CASI; A02, Hardcopy

The US Army conducted a comprehensive front-end analysis (FEA) which surveyed key users and identified critical issues and requirements for developing new load bearing equipment (LBE). From the FEA a detailed users' operational requirements document (ORD) was developed and from both the FEA and ORD the MOLLE emerged. The results of these efforts reveal several things about the methods used, as well as, issues and features of the system developed. This paper discusses the lessons learned about test methodology and features of LBEs found to work or not work for the dismounted combatant.
Author
Weight (Mass); Military Technology; Modularity

20010058968 Defence and Civil Inst. of Environmental Medicine, Operational Human Engineering Group, Toronto, Ontario Canada
Human Factors Engineering in the Development of a New Load Carriage System for the Canadian Forces
Bossi, L. L., Defence and Civil Inst. of Environmental Medicine, Canada; Tack, D. W., HumanSystems, Inc., Canada; Soldier Mobility: Innovations in Load Carriage System Design and Evaluation; May 2001, pp. 18A-1 - 18A-22; In English; See also 20010058955; Original contains color illustrations; Sponsored in part by CTS, DLR, and DSSPM; Copyright Waived; Avail: CASI; A03, Hardcopy

Human Factors Engineering (HFE) is contributing significantly to Canadian soldier protective clothing and personal equipment development and acquisition. From the conduct of user surveys and studies of baseline system performance, through the execution of controlled trials with representative users in the laboratory or the field, HFE is now impacting on virtually every

stage of the Canadian soldier system development and acquisition cycle. This is especially the case for the development and acquisition of a new load carriage system for the Canadian Forces, under the auspices of the 'Clothe the Soldier" project. The integrated design team, led by DCIEM, involved experts in HFE, biomechanics and load carriage system design from the Department of National Defence, academia and industry. The team followed a user-centered iterative design and evaluation process to rapidly develop an integrated load carriage system that will meet the range of needs of Canadian soldiers. The system includes a tactical vest, a large rucksack and small pack system, each with removable and interchangeable storage pouches making it adaptable or configurable according to mission, environment, and individual needs. The paper will present an overview of the Human Factors systems design approach used to identify and validate user requirements, and will highlight some of the many lab and field evaluations and analyses used to make design and procurement decisions.
Author
Defense Industry; Human Factors Engineering; Product Development

20010058969 Defence Clothing and Textiles Agency, R and T Group, Colchester, UK
Material Choices for Good Load Carriage Design
Davies, Gareth, Defence Clothing and Textiles Agency, UK; Soldier Mobility: Innovations in Load Carriage System Design and Evaluation; May 2001, pp. 18B-1 - 18B-3; In English; See also 20010058955; Copyright Waived; Avail: CASI; A01, Hardcopy

The paper discusses the selection of fabrics, webbing, tapes, sewing threads and the issues that surround their choice in the military scenario. How infrared signature is achieved on synthetic materials, so that service personnel are hidden from night sights, is explained. A weldable material has been identified in the UK offering the opportunity to produce waterproof rucksacks. The choice of interface materials to the body is discussed and the new favoured double needle bar spacer fabric with its advantages on heat stress and load distribution capabilities is compared to the established plastic foams. The selection of buckles and the way to improve their robustness is shown. The age-old argument of internal frame versus external frame is debated.
Author
Fabrics; Military Technology; Tensile Strength

20010058970 Queens Univ., School of Physical and Health Education, Kingston, Ontario Canada
Biomechanical Assessment Rucksack Shoulder Strap Attachment Location: Effect on Load Distribution to the Torso
Reid, S. A., Queens Univ., Canada; Bryant, J. T., Queens Univ., Canada; Stevenson, J . M., Queens Univ., Canada; Doan, J. B., Queens Univ., Canada; Soldier Mobility: Innovations in Load Carriage System Design and Evaluation; May 2001, pp. 20-1 - 20-8; In English; See also 20010058955; Original contains color illustrations
Contract(s)/Grant(s): W7711-7-7412/001/SRV; Copyright Waived; Avail: CASI; A02, Hardcopy

The objective of this study was to conduct biomechanical testing of pack component options to determine the optimal location for the lower attachment of the shoulder strap for the Clothe the Soldier (CTS) Integrated Patrol Pack and Rucksack. A model of a 50th percentile male torso has been split transversely at T12/L1 and instrumented with two six degree of freedom load cells. The shoulder area of the manikin was instrumented with Fscan(tm) sensors to record the contact pressure distribution in the axilla (armpit) and anterior of the shoulder under the shoulder strap. A 25 kg fixed payload was used for all test configurations. Waist belt, load lifter and shoulder strap tensions were constant during testing. Output variables were reaction forces at T12/L1, waist belt lifting force, average, and peak contact pressures about the shoulder. These were examined as a function of the attachment point location and as a function of the angle the shoulder strap made with respect to the body long axis. Strap angles above 30 degrees resulted in peak axilla contact pressures ranging from 35 to 64 kPa. At strap angles less than 24 degrees, anterior shoulder peak pressures of is greater than 32 kPa were recorded. These two effects determined the upper and lower bounds of an optimal range of 24 to 30 degrees with respect to the vertical axis of the body. These results cannot be extrapolated to other attachment locations that were not tested and pertain only to the type of strap tested.
Author
Biodynamics; Position (Location); Weight (Mass); Mass Distribution; Straps; Human Performance

20010058971 Queens Univ., Ergonomics Research Group, Kingston, Ontario Canada
Biomechanical Assessment of Lateral Stiffness Elements in the Suspension System of a Rucksack
Reid, S. A., Queens Univ., Canada; Whiteside, R. A., Queens Univ., Canada; Soldier Mobility: Innovations in Load Carriage System Design and Evaluation; May 2001, pp. 19-1 - 19-6; In English; See also 20010058955; Original contains color illustrations
Contract(s)/Grant(s): W7711-8-7461/001/SRV; Copyright Waived; Avail: CASI; A02, Hardcopy

The purpose of this study was to examine the change in load distribution characteristics associated with adding lateral stiffness elements (rods) to a rucksack. A manikin was instrumented to allow determination of the load applied to the shoulders and upper torso independent of the load applied to the hips and lower trunk. Position and mass of the payload (25 kg) was fixed at the centre

of the volume of the rucksack and held constant during all testing. Results showed that this active stiffness element shifted 10% of the vertical load from the upper torso to the pelvic region with no adverse affect on other factors known to limit load carriage capacity. Lumbar shear load remained unchanged between the rod and no-rod conditions for all combinations of shoulder strap and waist belt tension. The lateral rods also provided a greater extensor moment about the medio-lateral axis at the L3-L4 level.
Author
Biodynamics; Shoulders; Straps; Torso; Weight (Mass); Bioengineering

20010058972 Queens Univ., School of Physical and Health Education, Kingston, Ontario Canada
Biomechanical Assessment of the Canadian Integrated Load Carriage System Using Objective Assessment Measures
Stevenson, Joan M., Queens Univ., Canada; Reid, Susan A., Queens Univ., Canada; Bryant, J. Tim, Queens Univ., Canada; Pelot, Ron P., Dalhousie Univ., Canada; Morin, Evelyn L., Queens Univ., Canada; Soldier Mobility: Innovations in Load Carriage System Design and Evaluation; May 2001, pp. 21-1 - 21-12; In English; See also 20010058955; Original contains color illustrations; Copyright Waived; Avail: CASI; A03, Hardcopy

The purpose of this study was to provide an overview of contributions by biomechanical testing to the design of the final Canadian Clothe the Soldier (CTS) load carriage (LC) system. The Load Carriage Simulator and Compliance tester were used during design of the CTS system for evaluation of: three fragmentation vests, seven Tactical Vests and three iterations of the rucksack. Test data were compared to a data pool of previously tested systems. Results indicated that the objective measures helped the design team by: (1) understanding the consequences of various design changes; (2) predicting soldiers' responses to design changes in pressure, force and relative motion; (3) comparing this system objectively to other systems; and (4) providing information quickly so that ideas could be incorporated into the next design iteration. It was concluded that objective assessments added valuable information not easily interpreted from human trials. However, objective assessments cannot replace human trials for feedback on functionality and features.
Author
Biodynamics; Weight (Mass); Evaluation

20010058973 Loughborough Univ. of Technology, Dept. of Human Sciences, UK
Military Load Carriage: A Novel Method of Interface Pressure Analysis
Martin, Jennifer, Loughborough Univ. of Technology, UK; Hooper, Robin, Loughborough Univ. of Technology, UK; Soldier Mobility: Innovations in Load Carriage System Design and Evaluation; May 2001, pp. 22-1 - 22-8; In English; See also 20010058955; Copyright Waived; Avail: CASI; A02, Hardcopy

In the current military climate there is a constant need to strike a balance between the increasing amount of equipment carried by the modern soldier and the need to optimise performance and health. In co-operation with the Defence Clothing and Textile Agency, load carriage equipment has been developed making use of novel interface materials. These are used to distribute interface contact areas more extensively yet maintain air space next to the body surface. The purpose is to minimise peak pressure zones and reduce discomfort and pain so as to optimise performance and reduce the opportunity for injury. The paper will present novel methods for analysing interface pressures measured during load carriage on a treadmill and will consider the efficacy of this brief, evaluative technique.
Author
Weight (Mass); Equipment Specifications; Human Performance

20010058975 Queens Univ., School of Physical and Health Education, Kingston, Ontario Canada
Calibration Issues of Tekscan Systems for Human Pressure Assessment
Morin, E. L., Queens Univ., Canada; Bryant, J. T., Queens Univ., Canada; Reid, S. A., Queens Univ., Canada; Whiteside, B., Queens Univ., Canada; Soldier Mobility: Innovations in Load Carriage System Design and Evaluation; May 2001, pp. 24-1 - 24-7; In English; See also 20010058955; Original contains color illustrations; Copyright Waived; Avail: CASI; A02, Hardcopy

The Tekscan pressure sensor system has been designed for relatively easy measurement of contact pressures between two opposing surfaces. However, several factors are known to affect Tekscan sensor output. This paper reports on two pilot studies which were done to investigate the effects of contact surface compliance and changes in the system hardware on Tekscan sensor output. In the first study, linear calibration curves were calculated for a single Tekscan sensor array placed on surfaces of varying compliance. The slopes of the curves and variability in both the slopes and intercepts were found to be affected by surface compliance. In the second study, absolute percentage differences in the raw output data bits between a series of Tekscan sensor-cuff combinations were calculated. These differences ranged from 5-32%. The results of these studies indicate that careful

attention must be paid to system set-up and calibration when using the Tekscan pressure sensor system to measure contact pressures.
Author
Calibrating; Pressure Measurement; Pressure Sensors; Variability

20010058976 Dalhousie Univ., Dept. of Industrial Engineering, Halifax, Nova Scotia Canada
A Static Biomechanical Load Carriage Model
Pelot, R. P., Dalhousie Univ., Canada; Rigby, A., Queens Univ., Canada; Stevenson, J. M., Queens Univ., Canada; Bryant, J. T., Queens Univ., Canada; Soldier Mobility: Innovations in Load Carriage System Design and Evaluation; May 2001, pp. 25-1 - 25-12; In English; See also 20010058955; Sponsored in part by Defence R&D, Canada; Copyright Waived; Avail: CASI; A03, Hardcopy

A two-dimensional biomechanical model of a back-pack has been developed which incorporates the primary forces at the shoulder and waistbelt contact points. The model had been validated using instrumented manikins in laboratory experiments. The computer-based formulation allows the user to specify parameters for certain pack features, such as pack mass and volume, and it predicts the resulting contact forces on the bearer. by treating some parameters as decision variables, such as the location of attachment of the shoulder straps to the pack, the model can be used as an optimization tool to achieve a specified objective, such as minimizing the total forces on the bearer. A base case analysis and some variants illustrate this type of analysis. For the example provided, it is not possible to find a feasible solution within the prescribed shoulder-to-waist load ratio. by freeing up other variables, several alternative solutions are presented. This model can be used to easily examine trade-offs in certain pack design decisions.
Author
Biodynamics; Position (Location); Two Dimensional Models; Computerized Simulation; Weight (Mass)

20010058977 Salford Univ., School of Aeronautical and Mechanical Engineering, UK
Identifying and Modelling the Dynamic Behaviour of Load Carriage Systems
Gretton, Michelle, Salford Univ., UK; Howard, David, Salford Univ., UK; Soldier Mobility: Innovations in Load Carriage System Design and Evaluation; May 2001, pp. 27-1 - 27-5; In English; See also 20010058955; Copyright Waived; Avail: CASI; A01, Hardcopy

This paper describes a UK MOD funded research project that aims to identify mathematical models for the dynamic behaviour of backpack suspensions. A test-rig is described which can be used to collect the dynamic data required, and the processing of the data is briefly discussed. The resulting pack suspension models can be combined with a human locomotion model, and used to study the effects of design changes that alter pack dynamics.
Author
Dynamic Characteristics; Locomotion; Mathematical Models; Weight (Mass)

20010059253 NASA Lewis Research Center, Cleveland, OH USA
Moonwalking Series, Episode 2: Adapting to a Space Environment
[2001]; In English; Videotape: 29 min. 13 sec. playing time, in color, with sound
Report No.(s): NONP-NASA-VT-2001095020; No Copyright; Avail: CASI; B02, Videotape-Beta; V02, Videotape-VHS

This episode (second in a four-part series) shows the procedures Apollo operators used in order to make sure the astronauts would be able to survive in outer space, namely testing man's limitations and preferences (atmospheric pressure, temperature range, breathing gas, acceleration protection) and adapting the Columbia Module to account for these limitations. This show explains the function of the different stages of the moon rocket, i.e., how the stages separate and what becomes of them. We pick up the moonwalk story by looking back at some of the old classic space films that were a Hollywood perspective on future space travel.
Author (revised)
Aerospace Environments; Astronauts; Moon; Astronaut Training; Extravehicular Activity

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MATHEMATICAL AND COMPUTER SCIENCES (GENERAL)

Includes general topics and overviews related to mathematics and computer science. For specific topics in these areas see categories 60 through 67.

20010055578 FROM
Toeplitz Schur Multipliers of Sp(L(2)(G)) for p Less Than 1
Aleksandrov, A. B.; Aug. 2000; 16p; In English
Report No.(s): PB2001-105064; IHES/M/00/53; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
We study Toeplitz Schur miltipliers of Schatten-von Neumann class Sp for 0 is less than p is less than 1. We describe all functions F on an arbitrary commutative locally compact group G satisfying the following condition. For any integral operator in Sp with kernel function k(x,y), the kernal function F(x-y)k(x)k(y) defines also an integral operator in Sp.
NTIS
Kernel Functions; Multipliers; Mathematical Models

20010055579 FROM
Pathways of Deduction
Carbone, A.; Oct. 2000; 28p; In English
Report No.(s): PB2001-105061; IHES/M/00/68; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
Different models of various regions of the brain have been proposed and they stimulated the discussion on the way our mind works. In this paper, we would like to show how the usual hierarchical approach to the construction of formal mathematical proofs (introduced with the work of Frege and established through the work in logic until this last decade) is inappropriate to reveal the intricate structures underlying proofs.
NTIS
Mathematical Models; Hierarchies; Mathematical Logic; Brain

20010055585 FROM
Relative Yamabe Invariant
Akutagawa, K.; Botinnik, B.; Aug. 2000; 30p
Report No.(s): PB2001-105063; IHES/M/00/56; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
We define a relative Yamabe invariant of a smooth manifold with given conformal class on its boundary. In the case of empty boundary the invariant coincides with the classic Yamabe invariant. It develops approximation technique which leads to gluing theorems of two manifolds along their boundaries for the relative Yamabe invariant. There are many examples of manifolds with both positive and non-positive relative Yamabe invariants.
NTIS
Manifolds (Mathematics); Boundaries; Approximation

20010055586 FROM
Defect Relations on Semi-Abelian Varieties
McQuillan, M.; Dec. 2000; 32p
Report No.(s): PB2001-105059; IHES/M/00/82; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
Regardless of whether the authors choose an analytic or arithmetic flavor they can measure the degree of a map to varieties with respect to (metricized) divisors whether the map be holomorphic from the affine line A(sup 1) or a S point of some scheme. As is well known the main difference between such an intersection theory and a classical one is that there arises so called proximity functions, which so to speak complete the intersection theory over the boundary, i.e., the usual boundary of a disc in the analytic case, or the set of places delta in the arithmetic case - such functions will be denoted by m's with appropriate subscripts.
NTIS
Maps; Defects; Boundaries

20010056319 FROM
Classical Yang-Baxter Equation and the A infinity-Constraint
Polishchuk, A.; Aug. 2000; 32p; In English
Report No.(s): PB2001-105065; IHES/M/00/52; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
No abstract available.
NTIS
Tensors; Yang-Mills Theory; Tensor Analysis

20010056320 FROM
Brauer Points on Fermat Curves
McCallum, W. G.; Dec. 2000; 20p
Report No.(s): PB2001-105060; IHES/M/00/79; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
No abstract available.
NTIS
Curves (Geometry); Fermat Principle

20010056321 FROM
3-SASakian Geometry, Nilpotent Orbits, and Exceptional Quotients
Boyer, C. P.; Galicki, K.; Piccinni, P.; Jul. 2000; 28p; In English
Report No.(s): PB2001-105066; IHES/M/00/51; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
No abstract available.
NTIS
Manifolds (Mathematics); Quotients

20010056322 FROM
Floquet Spectrum of Weakly Coupled Map Lattices.
Baladi, V.; Rugh, H. H.; Jan. 2001; 28p
Report No.(s): PB2001-105056; IHES/M/01/02; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
No abstract available.
NTIS
Floquet Theorem; Lattices (Mathematics); Linear Equations

20010056323 FROM
Rational Curves on Foliated Varieties
Bogomolov, F. A.; McQuillan, M. L.; Feb. 2001; 36p; In English
Report No.(s): PB2001-105054; IHES/M/01/07; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
This article represents a study of ample subbundles of the tangent sheaf of a variety in a formal neighborhood of a curve. With the added hypothesis of intergrability it is best possible. A particular corollary is Mori's cone theorem for foliations by curves.
NTIS
Tangents; Theorems; Curvature; Singularity (Mathematics); Curves (Geometry)

20010056324 FROM
Nice Map Colour Theorem
Sarkaria, K. S.; Feb. 2001; 24p; In English
Report No.(s): PB2001-105053; IHES/M/01/08; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
A closed orientable surface is 'nice' if its vertices can be assigned 4 colors in such a way that all the 4 colors are used in the closed star of each edge. The 4-coloring can be interpreted as a simplicial map from the surface to the 4-vertex 2-sphere. If the surface has genus (n-1)(sup 2) for which the degree of the above map is at least n(sup 2). Conversely the authors show that, if n is not divisible by 2 and 3, then there are 'nice' surfaces of genus (n-1)(sup 2) for which the degree of the above map is exactly n(sup 2). Complex analytically 'nice' surfaces can be viewed as minimally triangulated meromorphic functions of a Riemann surface.
NTIS
Color; Meromorphic Functions; Mapping; Spheres

20010056665 Institut des Hautes Etudes Scientifiques, Bures-sur-Yvette, France
E(10), BE(10) and Arithmetical Chaos in Superstring Cosmology
Damour, T., Institut des Hautes Etudes Scientifiques, France; Henneaux, M., Free Univ., Belgium; Dec. 19, 2000; 10p; In English
Report No.(s): PB2001-105068; IHES/P/00/83; No Copyright; Avail: CASI; A01, Microfiche; A02, Hardcopy

It is shown that the never ending oscillatory behavior of the generic solution, near a cosmological singularity, of the massless bosonic sector of superstring theory can be described as a billiard motion within a simplex in 9-dimensional hyperbolic space. The Coxeter group of reflections of this billiard is discrete and is the Weyl group of the hyperbolic Kac-Moody algebra E(10) (for type II) or BE(10) (for type I or heterotic), which are both arithmetic. These results lead to a proof of the chaotic ('Anosov') nature of the classical cosmological oscillations, and suggest a 'chaotic quantum billiard' scenario of vacuum selection in string theory.
NTIS
Algebra; Chaos; Cosmology; String Theory; Hyperbolic Coordinates

20010057615 Institut des Hautes Etudes Scientifiques, Bures-sur-Yvette, France
Polynomial Eigenfunctions of d(sup k)/dx(sup k) Q(x)
Masson, G.; Shapiro, B.; Jan. 2001; 20p; In English
Report No.(s): PB2001-105055; IHES/M/01/04; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

No abstract available.
NTIS
Eigenvectors; Polynomials

20010057618 Rennes Univ., Inst. de Recherche Mathematique, France
Complexity of Positivstellensatz Proofs for the Knapsack
Grigoriev, D.; Feb. 2001; 24p; In English
Report No.(s): PB2001-105052; IHES/M/01/09; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

It is established a lower bound on degrees of Positivstellensatz calculus refutations (over a real field) introduced in (GV 99), (G 99), for the knapsack problem. The bound depends on the values of coefficients of an instance of the knapsack problem: for certain values the lower bound is linear and for certain values the upper bound is constant, while in the polynomial calculus the degree is always linear (regardless of the values of coefficients) (IPS 97). This shows that the Positivstellensatz calculus could be strictly stronger than the polynomial calculus from the point of view of the complexity of the proofs.
NTIS
Polynomials; Theorems; Calculus; Proving

20010057877 Institut des Hautes Etudes Scientifiques, Bures-sur-Yvette, France
Manifold of Positive Scalar Curvature and Conformal Cobordism Theory
Akutagawa, K.; Botvinnik, B.; Aug. 2000; 28p; In English; Sponsored in part by Sonderforschungsbereich 478
Contract(s)/Grant(s): MOE-09640102
Report No.(s): PB2001-105051; IHES/M/00/57; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The authors study compact manifolds with positive scalar curvature metrics. The authors use the relative invariant to define the conformal cobordism relation on the category of such manifolds. The authors prove that corresponding conformal cobordism groups Pos(sub n)(sup Conf)(Gamma) are isomorphic to the cobordism groups Posn(Gamma) defined topologically by S. Stolz. As a corollary the authors show that the conformal concordance of positive scalar curvature metrics coincides with the standard concordance relation. The authors' main technical tools came from the analysis and conformal geometry.
NTIS
Curvature; Manifolds (Mathematics); Scalars

20010058724 Institut des Hautes Etudes Scientifiques, Bures-sur-Yvette, France
Mathemagics (A Tribute to L. Euler and R. Feynman)
Cartier, P.; Jul. 2000; 68p; In English
Report No.(s): PB2001-105123; IHES/M/00/48; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

The implicit philosophical belief of the working mathematician is today the Hilbert-Bourbaki formalism. Ideally, one works within a closed system: the basic principles are clearly enunciated once for all, including (that is an addition of twentieth century science) the formal rules of logical reasoning clothed in mathematical form. The basic principles include precise definitions of

all mathematical objects, and the coherence between the various branches of mathematical sciences is achieved through reduction to basic models in the universe of sets.
NTIS
Formalism; Universe; Mathematics

20010058725 Institut des Hautes Etudes Scientifiques, Bures-sur-Yvette, France
Cyclic Operads and Algebra of Chord Diagrams
Hinich, V.; Vaintrob, A.; Aug. 2000; 52p; In English
Report No.(s): PB2001-105122; IHES/M/00/61; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche
It is well known that the theory of knot invariants of finite type (or Vassiliev invariants) is closely connected with Lie algebras. The aim of this paper is to clarify this relationship and give it a precise formulation.
NTIS
Lie Groups; Chords (Geometry)

60
COMPUTER OPERATIONS AND HARDWARE

Includes hardware for computer graphics, firmware and data processing. For components see 33 Electronics and Electrical Engineering. For computer vision see 63 Cybernetics, Artificial Intelligence and Robotics.

20010055261 Old Dominion Univ., Dept. of Computer Science, Norfolk, VA USA
An Approach to the Reuse of Technical Materials for Educational Purposes ***Final Report***
Levinstein, Irwin, Old Dominion Univ., USA; [2001]; 6p; In English
Contract(s)/Grant(s): NAG1-2323; ODURF Proj. 104591; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche
This project addresses the problem of transforming technical documents intended for a technical audience into educational materials directed toward segments of the general public. In particular it addresses the conversion of technical material into Internet based educational materials. A major consideration of the project is the conservation of the time of subject matter experts in the organization in recognition of the fact that such experts are likely to be more valuable to the organization for purposes other than the production of educational outreach.
Derived from text
Information Transfer; Technical Writing; Internets; Software Development Tools

20010059185 Los Alamos National Lab., NM USA
Design Issues for Hardware Implementation of an Algorithm for Segmenting Hyperspectral Imagery
Theiler, J.; Leeser, M.; Estlick, M.; Szymanski, J. J.; Oct. 26, 2000; 16p; In English; SPIE Conference Session AM 104 Imaging Spectrometry VI, 30 Jul. - 4 Aug. 2000, San Diego, CA, USA; Sponsored by International Society for Optical Engineering, USA
Report No.(s): PB2001-105679; No Copyright; Avail: National Technical Information Service (NTIS)
Modern hyperspectral imagers can produce data cubes with hundreds of spectral channels and millions of pixels. One way to cope with this massive volume is to organize the data so that pixels with similar spectral content are clustered together in the same category. This provides both a compression of the data and a segmentation of the image that can be useful for other image processing tasks downstream. The classic approach for segmentation of multidimensional data is the k-means algorithm; this is an iterative method that produces successively better segmentations. It is a simple algorithm, but the computational expense can be considerable, particularly for clustering large hyperspectral images into many categories. The ASAPP (Accelerating Segmentation And Pixel Purity) project aims to relieve this processing bottleneck by putting the k-means algorithm into field-programmable gate array (FPGA) hardware. The standard software implementation of k-means uses floating-point arithmetic and Euclidean distances. by fixing the precision of the computation and by employing alternative distance metrics (we consider the 'Manhattan' and the 'Max' metrics as well as a linear combination of the two), we can fit more distance-computation nodes on the chip, obtain a higher degree of fine-grain parallelism, and therefore faster performance, but at the price of slightly less optimal clusters. We investigate the effects of different distance metrics from both a theoretical (using random simulated data) and an empirical viewpoint (using 224-channel AVIRIS images and 10-channel multispectral images that are derived from the AVIRIS data to simulate MTI data).
NTIS
Image Processing; Hardware; Algorithms; Design Analysis

61
COMPUTER PROGRAMMING AND SOFTWARE

Includes software engineering, computer programs, routines, algorithms, and specific applications, e.g., CAD/CAM. For computer software applied to specific applications, see also the associated category.

20010054778 Ljubljana Univ., Faculty of Electrical Engineering, Ljubljana, Slovenia
Integration of Generic Optimisation Algorithms in SPICE ***Vgradnja genericnih optimizacijskih algoritmov v SPICE***
Puhan, Janez, Ljubljana Univ., Slovenia; Fajfar, Iztok, Ljubljana Univ., Slovenia; Tuma, Tadej, Ljubljana Univ., Slovenia; Buermen, Arpad, Ljubljana Univ., Slovenia; Electrotechnical Review; 2001; ISSN 0013-5852; Volume 68, No. 1, pp. 70-73; In English; Copyright; Avail: Issuing Activity

Though rather awkward and limited in its usage, SPICE has been used by several authors solving their various optimisation problems. In this paper we propose how some generic optimisation algorithms can be integrated into SPICE. The implemented program has proven to be an extremely efficient optimisation tool for an experienced circuit designer. It is free of charge available at our web site (http://fides.fe.uni-Ij.si/spice/).
Author
Algorithms; Optimization; Circuits; Computer Aided Design; Computer Programming; Software Engineering

20010055576 FROM
Core Product Model For Representing Design Information
Fenves, S. J.; Apr. 2001; 44p
Report No.(s): PB2001-105378; NISTIR-6736; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The report presents a core model for representing design information, motivated by the perceived needs of next-generation product development systems and drawing content-level requirements from a related study of design information flows. The core model was synthesized from a comparison of several independently-developed design artifact representations. The primary objective of the report is to provide a base-level product model that is not tied to any vendor software; open; non-proprietary; simple; generic; expandable; independent of any one product development process; and capable of capturing the engineering context that is most commonly shared in product development activities. The core model focuses on artifact representation including function, form, behavior and material, physical and functional decompositions, and relationships among these concepts. The model is heavily influenced by the Entity-Relationship data model; accordingly, it consists of two sets of classes, called object and relationship, equivalent to the UML class and association class, respectively. It is expected that the core model may eventually serve as a precursor for STEP in the lifecycle of a product, capturing all information relevant to the ongoing design process until the product design is firmed up, approved and committed to purchasing or manufacturing. Aspects of extensions of the model in these directions are discussed.
NTIS
Product Development; Computer Aided Design; Computerized Simulation

20010055668 Army School of Aviation Medicine, Fort Rucker, AL USA
Distance Learning: Has the Training Culture Kept Up with the Technology Available, ***15 Feb. 2000 - 30 Apr. 2000***
McKeon, Joseph; May 2000; 4p; In English
Report No.(s): AD-A388845; No Copyright; Avail: CASI; A01, Microfiche; A01, Hardcopy

The US Army School of Aviation Medicine (USASAM), in concert with the Center for Total Access (CTA), has developed a study comparing the effectiveness of computer-based learning versus traditional classroom didactic instruction, as measured by a standardized post-test. The accomplishments of the project to date include the following: Development of web-based, interactive course modules utilized to provide the DL instruction. These modules were based upon PowerPoint presentations that are given to resident students at USASAM. Development of a prototype course module interface. Alpha (focus group) testing was performed at the Army's Operational Aeromedical Problems Course (GAP) in Norfolk, Virginia. Beta testing was conducted at the US Army Flight Surgeon Primary Course at Fort Rucker. Internet domains have been registered at: www.avnrned.ha.osd.mil and at www.avnmed.org. Web sites were created on both the .mil and org domains to allow access from home, as well as clinic and deployed environments. Methodology decisions included utilizing a design for 800 X 600 monitor size, and to make the interface as simple as possible to use, for "non-web savvy'1 users The Macromedia Flash technology was chosen to deliver content in small file sizes to minimize download time. Lessons learned from alpha testing resulted in the creation of a navigation system that allows students to move back and forth from one slide to another, as well as scrolling through the presentation, or "jumping" back to a previous, non-sequential slide. In addition, users are able to interact with courses on-line, can read material or print it

for later study, in concert or independent of web site. This affords greater flexibility to the end user in choosing the conditions under which he/she learns optimally.
DTIC
Computer Assisted Instruction; Aerospace Medicine; On-Line Systems; Operational Problems; Education; Flight Surgeons; Internets

20010055679 Carnegie-Mellon Univ., Software Engineering Inst., Pittsburgh, PA USA
K-BACEE: A Knowledge-Based Automated Component Ensemble Evaluation Tool
Seacord, Robert C.; Mundie, David; Boonsiri, Somjai; Dec. 2000; 26p; In English
Contract(s)/Grant(s): F19628-00-C-0003
Report No.(s): AD-A389005; CMU/SEI-2000-TN-015; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Component reuse suffers from the inability of system integrators to effectively identify ensembles of compatible software components that can be easily integrated into a system. to address this problem, we have developed an automated process for identifying component ensembles that satisfy a system requirements specification; and for ranking these ensembles based on a knowledge base of system integration rules.
DTIC
Systems Engineering; Knowledge Based Systems; Computer Programs; Systems Integration; Integrators

20010057033 Argonne National Lab., Mathematics and Computer Science Div., IL USA
DSDP3: Dual Scaling Algorithm for General Positive Semidefinite Programming
Benson, S. J.; Ye, Y.; Feb. 12, 2001; 18p; In English; Prepared in cooperation with Iowa City Dept. of Management Sciences
Report No.(s): PB2001-105409; No Copyright; Avail: National Technical Information Service (NTIS)

We implement a dual scaling algorithm for positive programming to handle a broader class of problems than could be solved with previous implementations of the algorithm. With appropriate representations of constraint matrices, we can solve general semidefinite programs and still exploit the structure of large-scale combinatorial optimization problems. Computational results show that our preliminary implementation is competitive with primal-dual solvers on many problems requiring moderate precision in the solution and is superior to primal-dual solvers for several types of problems.
NTIS
Algorithms; Linear Programming; Scaling Laws

20010057070 Institute for Computer Applications in Science and Engineering, Hampton, VA USA
A Component-based Programming Model for Composite, Distributed Applications ***Final Report***
Eidson, Thomas M., Institute for Computer Applications in Science and Engineering, USA; May 2001; 18p; In English
Contract(s)/Grant(s): NAS1-97046; RTOP 505-90-52-01
Report No.(s): NASA/CR-2001-210873; NAS 1.26:210873; ICASE-2001-15; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The nature of scientific programming is evolving to larger, composite applications that are composed of smaller element applications. These composite applications are more frequently being targeted for distributed, heterogeneous networks of computers. They are most likely programmed by a group of developers. Software component technology and computational frameworks are being proposed and developed to meet the programming requirements of these new applications. Historically, programming systems have had a hard time being accepted by the scientific programming community. In this paper, a programming model is outlined that attempts to organize the software component concepts and fundamental programming entities into programming abstractions that will be better understood by the application developers. The programming model is designed to support computational frameworks that manage many of the tedious programming details, but also that allow sufficient programmer control to design an accurate, high-performance application.
Author
Computer Networks; Applications Programs (Computers); Composite Functions; Multiprogramming

20010057299 NASA Johnson Space Center, Houston, TX USA
Development of a Space Radiation Monte-Carlo Computer Simulation Based on the FLUKE and Root Codes
Pinsky, L. S., Houston Univ., USA; Wilson, T. L., NASA Johnson Space Center, USA; Ferrari, A., INFI, Italy; Sala, Paola, INFI, Italy; Carminati, F., European Organization for Nuclear Research, Switzerland; Brun, R., European Organization for Nuclear Research, Switzerland; Microgravity Materials Science Conference 2000; March 2001; Volume 2, pp. 465-470; In English; See also 20010057256; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A02, Hardcopy

The radiation environment in space is a complex problem to model. Trying to extrapolate the projections of that environment into all areas of the internal spacecraft geometry is even more daunting. With the support of our CERN colleagues, our research group in Houston is embarking on a project to develop a radiation transport tool that is tailored to the problem of taking the external radiation flux incident on any particular spacecraft and simulating the evolution of that flux through a geometrically accurate model of the spacecraft material. The output will be a prediction of the detailed nature of the resulting internal radiation environment within the spacecraft as well as its secondary albedo. Beyond doing the physics transport of the incident flux, the software tool we are developing will provide a self-contained stand-alone object-oriented analysis and visualization infrastructure. It will also include a graphical user interface and a set of input tools to facilitate the simulation of space missions in terms of nominal radiation models and mission trajectory profiles. The goal of this project is to produce a code that is considerably more accurate and user-friendly than existing Monte-Carlo-based tools for the evaluation of the space radiation environment. Furthermore, the code will be an essential complement to the currently existing analytic codes in the BRYNTRN/HZETRN family for the evaluation of radiation shielding. The code will be directly applicable to the simulation of environments in low earth orbit, on the lunar surface, on planetary surfaces (including the Earth) and in the interplanetary medium such as on a transit to Mars (and even in the interstellar medium). The software will include modules whose underlying physics base can continue to be enhanced and updated for physics content, as future data become available beyond the timeframe of the initial development now foreseen. This future maintenance will be available from the authors of FLUKA as part of their continuing efforts to support the users of the FLUKA code within the particle physics community. In keeping with the spirit of developing an evolving physics code, we are planning as part of this project, to participate in the efforts to validate the core FLUKA physics in ground-based accelerator test runs. The emphasis of these test runs will be the physics of greatest interest in the simulation of the space radiation environment. Such a tool will be of great value to planners, designers and operators of future space missions, as well as for the design of the vehicles and habitats to be used on such missions. It will also be of aid to future experiments of various kinds that may be affected at some level by the ambient radiation environment, or in the analysis of hybrid experiment designs that have been discussed for space-based astronomy and astrophysics. The tool will be of value to the Life Sciences personnel involved in the prediction and measurement of radiation doses experienced by the crewmembers on such missions. In addition, the tool will be of great use to the planners of experiments to measure and evaluate the space radiation environment itself. It can likewise be useful in the analysis of safe havens, hazard migration plans, and NASA's call for new research in composites and to NASA engineers modeling the radiation exposure of electronic circuits. This code will provide an important complimentary check on the predictions of analytic codes such as BRYNTRN/HZETRN that are presently used for many similar applications, and which have shortcomings that are more easily overcome with Monte Carlo type simulations. Finally, it is acknowledged that there are similar efforts based around the use of the GEANT4 Monte-Carlo transport code currently under development at CERN. It is our intention to make our software modular and sufficiently flexible to allow the parallel use of either FLUKA or GEANT4 as the physics transport engine.

Author

Monte Carlo Method; Computerized Simulation; Extraterrestrial Radiation; Environment Simulation; Radiation Shielding; Radiation Measurement; Aerospace Environments; Spacecraft Shielding; Spacecraft Structures; Computer Programs

20010057785 NASA Langley Research Center, Hampton, VA USA

Meshless Petrov-Galerkin Method Applied to Axisymmetric Problems

Raju, I. S., NASA Langley Research Center, USA; Chen, T., NASA Langley Research Center, USA; [2001]; 12p; In English

Report No.(s): AIAA Paper 2001-1253; Copyright Waived; Avail: CASI; A03, Hardcopy; A01, Microfiche

An axisymmetric Meshless Local Petrov-Galerkin (MLPG) algorithm is presented for the potential and elasticity problems. In this algorithm the trial and test functions are chosen from different spaces. by a judicious choice of these functions, the integrals involved in the weak form can be restricted to a local neighborhood. This makes the method truly meshless. The MLPG algorithm is used to study various potential and elasticity problems for which exact solutions are available. The sensitivity and effectiveness of the MLPG algorithm to various parameters such as the weight functions, basis functions and support domain radius, etc. was studied. The MLPG algorithm yielded accurate solutions for all weight functions, basis functions and support domain radii considered for all of the problems studied.

Author

Algorithms; Galerkin Method; Symmetry; Sensitivity; Effectiveness

20010057789 NASA Langley Research Center, Hampton, VA USA

A Practical Tutorial on Modified Condition/Decision Coverage

Hayhurst, Kelly J., NASA Langley Research Center, USA; Veerhusen, Dan S., Rockwell Collins, Inc., USA; Chilenski, John J., Boeing Co., USA; Rierson, Leanna K., Federal Aviation Administration, USA; May 2001; 85p; In English

Contract(s)/Grant(s): RTOP 728-30-10-03

Report No.(s): NASA/TM-2001-210876; L-18088; NAS 1.15:210876; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

This tutorial provides a practical approach to assessing modified condition/decision coverage (MC/DC) for aviation software products that must comply with regulatory guidance for DO-178B level A software. The tutorial's approach to MC/DC is a 5-step process that allows a certification authority or verification analyst to evaluate MC/DC claims without the aid of a coverage tool. In addition to the MC/DC approach, the tutorial addresses factors to consider in selecting and qualifying a structural coverage analysis tool, tips for reviewing life cycle data related to MC/DC, and pitfalls common to structural coverage analysis.

Author

Structural Analysis; Computer Programs

20010058726 Forest Products Lab., Madison, WI USA

Procedures for Developing Allowable Properties for a Single Species under ASTM D1990 and Computer Programs Useful for the Calculations

Evans, J. W.; Kretschmann, D. E.; Herian, V. L.; Green, D. W.; Apr. 2001; 46p; In English

Report No.(s): PB2001-103978; FPL-GTR-126; No Copyright; Avail: National Technical Information Service (NTIS)

ASTM D1990, 'Establishing Allowable Properties for Visually Graded Dimension Lumber from In-Grade Tests of Full-Size Specimens,' is the consequences standard used to make submissions of allowable properties for many U.S. Canadian, and foreign species to the Board of Review of the American Lumber Standards Committee. Recently, it has become apparent how difficult it is to perform the calculations for such a submission. Some calculations are clearly specified in the standard; in some cases the standard merely indicates a need to make an adjustment but does not specify how to do so. This report discusses in detail how to develop allowable properties under the standard in a manner that is consistent with current practices. Many calculations in the standard are difficult and errors are easily made, particularly when using a spreadsheet; this report introduced a set of computer programs that perform some of the difficult calculations, thereby reducing the potential for errors.

NTIS

Computer Programs; Properties

20010058866 Princeton Univ., Dept. of Computer Science, NJ USA

Comparison of Three Programming Models for Adaptive Applications on the Origin2000

Shan, H.; Pal Singh, J.; Oliker, L.; Biswas, R.; 2001; 24p; In English; Prepared in cooperation with National Energy Research Scientific Computing Center, Berkeley, CA

Report No.(s): PB2001-105595; No Copyright; Avail: National Technical Information Service (NTIS)

Adaptive applications have computational workloads and communication patterns which change unpredictably at runtime, requiring dynamic load balancing to achieve scalable performance on parallel machines. Efficient parallel implementations of such adaptive applications is therefore a challenging task. In this paper, we compare the performance of and the programming effort required for two major classes of adaptive applications under three leading parallel programming models on an SGI Origin2000 system, a machine which supports all three models efficiently. Results indicate that the three models deliver comparable performance; however, the implementations differ significantly beyond merely using explicit messages versus implicit loads/stores even though the basic parallel algorithms are similar. Compared with the message-passing (using MPI) and SHMEM programming models, the cache-coherent shared address space (CC-SAS) model provides substantial ease of programming at both the conceptual and program orchestration levels, often accompanied by performance gains. However, CC-SAS currently has portability limitations and may suffer from poor spatial locality of physically distributed shared data on large numbers of processors.

NTIS

Workloads (Psychophysiology); Parallel Programming; Parallel Processing (Computers)

20010059181 Los Alamos National Lab., NM USA

Hydrocode Sensitivities by Means of Automatic Differentiation

Henninger, R. J.; Carle, A.; Maudlin, P. J.; 2001; 10p; In English; 3th; International Symposium on Sensitivity Analysis of Model Output, 18-20 Jun. 2001, Madrid, Spain

Report No.(s): PB2001-106092; LA-UR-01-514; No Copyright; Avail: National Technical Information Service (NTIS)

The purpose of this project has been to provide sensitivities of results from an Eulerian hydrodynamics computer code (hydrocode) for use in design-optimization and uncertainty analyses. We began by applying an equation-based sensitivity technique used successfully in the early eighties that was applied to reactor-safety thermal-hydraulics problems, which is called Differential Sensitivity Theory (DST). The methodology is as follows: the system of partial differential equations (the forward or physical PDEs) is assembled, and differentiated with respect to the model parameters of interest; the adjoint equations are then determined using the inner-product rules of Hilbert spaces; and finally, the resulting adjoint PDEs are solved using straightforward numerical operators. The forward-variable solutions when needed for the adjoint solutions are provided by the original computer code that solves the physical (or forward) problem. In the present hydrocode application, acceptable results were obtained for one-material, one-dimensional problems. The DST results were then improved by means of 'compatible' finite difference operators. We have seen, however, that DST techniques do not produce accurate values for sensitivities to all of the parameters of interest and for problems with discontinuities such as a multi-material problem. to obtain accurate sensitivities for arbitrary numerical resolution a more code-based approach was then tried. We attempted to apply automatic differentiation (AD) in the forward mode using Automatic DIfferentiation of FORtran (ADIFOR, version 2.0) and the Tangent-linear and Adjoint Model Compiler (TAMC) in the forward and adjoint modes. We were successful for one-dimensional problems in both modes but failed to obtain accurate sensitivities in the adjoint mode for two-dimensional problems. Here we present the successful results for two-dimensional problems in both the forward and adjoint modes using ADIFOR, version 3.0. In what follows, we describe AD methods in the context of their use for a hydrocode. We then examine setup time, results, accuracy, and computer run times for three test problems obtained by ADIFOR. Finally, we outline our plans for future work.

NTIS

Computer Programs; Design Optimization; Hydrodynamics; Differentiation; Sensitivity

20010059327 Massachusetts Univ., Dept. of Computer Science, Amherst, MA USA

Ascender 2: Knowledge-Directed Image Understanding for Site Reconstruction ***Final Report, Apr 1997-May 1999***

Hanson, Allen, Massachusetts Univ., USA; Riseman, Edward, Massachusetts Univ., USA; Schultz, Howard, Massachusetts Univ., USA; Mar. 2001; 60p; In English

Contract(s)/Grant(s): DAAG55-97-1-0188

Report No.(s): AD-A388649; ERDC/TEC-CR-01-1; No Copyright; Avail: CASI; A01, Microfiche; A04, Hardcopy

The Ascender 2 system was designed to perform three dimensional reconstruction of cultural objects (primarily buildings) from multiple aerial images. It is based on the premise that cooperative redundant reconstruction algorithms will succeed where individual algorithms fail and that a major task for a vision system is deciding which algorithm to apply to what data (and when). Control is based on Bayesian networks and utility theory is used to compute the marginal value of information for alternative operators and to select the one with the highest return. Two reconstruction algorithms are described that, along with other techniques, form the repertoire of algorithms. One algorithm reconstructs a 3-dimensional model of the scene using the differential geometry of scene surfaces to index into a set of model surfaces. A robust surface optimization converges on the model and parameters that most closely describe the data. After the best-fit surface has been determined, an outlier analysis phase searches for substructures that are recursively processed. The second algorithm recovers geometric structure from SAR and IFSAR data. The presence of noise missing data and poorly understood radar artifacts in such images necessitates the use of robust and context-sensitive technique. The algorithm exploits knowledge about the geometric structure of buildings and how this geometry interacts with the sensor.

DTIC

Image Processing; Knowledge Based Systems; Synthetic Aperture Radar; Aerial Photography; Surface Geometry

62
COMPUTER SYSTEMS

Includes computer networks and distributed processing systems. For information systems see 82 Documentation and Information Science. For computer systems applied to specific applications, see the associated category.

20010054774 Ljubljana Univ., Fakulteta za Racunalnistvo in Informatiko, Ljubljana, Slovenia
Computer Networks and Routing Models ***Racunalniska Omrezja in Usmerjevalni Modeli***
Dobravec, Tomaz, Ljubljana Univ., Slovenia; Robic, Borut, Ljubljana Univ., Slovenia; Vilfan, Bostjan, Ljubljana Univ., Slovenia; Electrotechnical Review; 2001; ISSN 0013-5852; Volume 68, No. 1, pp. 7-12; In Slovene; Copyright; Avail: Issuing Activity

In the paper we discuss fundamental issues on communication in multiprocessor systems including the topology of the underlying network, its regularity, and scalability. After pointing out the basic limitations of interconnection networks, we define and discuss general properties of computer networks, such as network topology, regularity, vertex neighborhood, vertex degree, distance between vertices, network diameter, scalability, and fault tolerance. Next, networks with special topologies are analyzed, such as linear network, ring, fully connected network, hypercube, tree, star, mesh torus and circulant network. This static view of computer networks is followed by issues related to dynamic properties of the networks, in particular routing models. We discuss circuit switching, routing along network of buses, as well as packet routing. Four different approaches to solving packet collisions are analyzed: buffering, blocking, dropping, and misrouting. We also discuss wormhole and store- and-forward routing. Finally, the SIMD and MIMD routing models are described.
Author
Computer Networks; Dynamic Characteristics; Multiprocessing (Computers); Switching; Models; Parallel Processing (Computers); Interprocessor Communication; Network Control

20010054979 Carnegie-Mellon Univ., Software Engineering Inst., Pittsburgh, PA USA
The Survivability of Network Systems: An Empirical Analysis ***Final Report***
Moitra, SOumyo D.; Konda, Suresh L.; Dec. 2000; 57p; In English
Contract(s)/Grant(s): F19628-95-C-0003
Report No.(s): AD-A388774; CMU/SEI-2000-TR-021; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

This report presents an extended analysis of CERT Coordination Center incidents data (from 1988 to 1995) and applies the results to simulate attacks and their impacts on network sites. The data were ”sanitized” prior to the analysis to ensure complete anonymity. A model for the incidents process is discussed and extended. It consists of three parts: a stochastic process for the random occurrence of incidents at sites, a model for the state transition process for an attacked system given a level of defense, and a method of estimating the expected survivability of the system given possible degradations due to these attacks. This approach leads to the estimation of a survivability/cost function, which shows the tradeoffs involved between cost and system survivability. IS managers can use this to determine the most appropriate level of defense for the network systems of their organizations. The stochastic process was simulated based on parameter values obtained from actual reported data. Extensive sensitivity analyses are reported that indicate how expected survivability would change with varying parameter analysis results values. The report concludes with a discussion of future work to be done and the appendix has details of the simulation model and further data.
DTIC
Computer Networks; Mathematical Models

20010054981 Carnegie-Mellon Univ., Software Engineering Inst., Pittsburgh, PA USA
Attack Modeling for Information Security and Survivability ***Final Report***
Moore, Andrew P.; Ellison, Robert J.; Linger, Richard C.; Mar. 2001; 32p; In English
Contract(s)/Grant(s): F19628-00-C-0003
Report No.(s): AD-A388771; CMU-SEI-2001-TN-001; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Many engineering disciplines rely on engineering failure data to improve their designs. Unfortunately, this is not the case with information system engineers, who generally do not use security failure data-particularly attack data-to improve the security and survivability of systems that they develop. Part of the reason for this is that, historically, businesses and governments have been reticent to disclose information about attacks on their systems for fear of losing public confidence or for fear that other attackers would exploit the same or similar vulnerabilities. Specific, detailed attack data has just not been available. However, increased public interest and media coverage of the Internet’s security have resulted in increased publication of attack data in books, Internet newsgroups, and CERT security advisories, for example. Engineers can now use this data in a structured way to improve information system security and survivability. This technical note describes and illustrates an approach for documenting attack

information in a structured and reusable form. We expect that security analysts can use this approach to document and identify commonly occurring attack patterns, and that information system designers and analysts can use these patterns to develop more survivable information systems.
DTIC
Information Systems; Computer Information Security

20010058880 Los Alamos National Lab., NM USA
Network Traffic Characterization of TCP
Feng, W.; 2001; 12p; In English; Submitted to the 2000 Military Communications International Symposium (MILCOM 2000)
Report No.(s): PB2001-105671; LA-UR-00-2895; No Copyright; Avail: National Technical Information Service (NTIS)

Many research efforts in network traffic characterization conclude that network traffic is self-similar (i.e., fractal or bursty), and thus not amenable to the statistical-multiplexing techniques currently found in the Internet. In particular they claim that the heavy-tailed distributions of file size, packet interarrival, and transfer duration solely contribute to the self-similarity of aggregate network traffic. In contrast, we demonstrate that it is the TCP stack itself that induces much of the self-similar behavior even when aggregated application traffic should smooth out as more applications traffic are multiplexed.
NTIS
Computer Networks; Traffic

20010059592 Sandia National Labs., Albuquerque, NM USA
Examination of System Architectures for Distributing Sensor Data Via Ethernet Networks
Pfeifer, K. B.; Cernosek, R. W.; Martin, S. J.; Waldschmidt, R. L.; Rump, A. N.; Jan. 2001; 40p; In English; Original contains color illustrations
Report No.(s): PB2001-106081; SAND2000-3228; No Copyright; Avail: National Technical Information Service (NTIS)

Application of the World Wide Web (WWW) for the transfer of sensor data from remote locations to laboratories and offices is a largely ignored application of the WWW. We have investigated several architectures for this application including simple web server/client architectures and variations of this approach. In addition, we have evaluated several commercial approaches and other techniques that have been investigated and are in the literature. Finally, we have provided conclusions based on the results of our study offering suggestions about the advantages and disadvantages of each of the approaches studied.
NTIS
World Wide Web; Ethernet; Architecture (Computers)

63
CYBERNETICS, ARTIFICIAL INTELLIGENCE AND ROBOTICS

Includes feedback and control theory, information theory, machine learning, and expert systems. For related information see also 54 Man/System Technology and Life Support.

20010054977 Massachusetts Inst. of Tech., Lab. of Electronics, Cambridge, MA USA
Training Spatial Knowledge Acquisition Using Virtual Environments ***Annual Report, 1 Feb. 2000-31 Jan. 2001***
Durlach, Nathaniel; von Wiegand, Thomas E.; Brooks, Andrew; Delhorne, Lorraine; Pfautz, Johnathon; Apr. 23, 2001; 8p; In English
Contract(s)/Grant(s): N00014-96-1-0379
Report No.(s): AD-A388889; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

This report summarizes the work done by MIT in Year 5 (1 February 2000 through 31 January 2001) of the ONR Grant N00014-96-1-0937 entitled ”Training Spatial Knowledge Acquisition Using Virtual Environments”. It has been prepared by Nathaniel Durlach (PI), Dr Thomas E. v. Wiegand, Andrew Brooks, Lorraine Delhorne and Jonathan Pfautz. Much of our effort during this period has been directed towards further refinement and development of the generic spatial-training simulation incorporating the World In Miniature (WIM), and the construction of a photorealistic model of a building at MIT for use in experiments involving this simulation. As part of this development, the entire simulation was rewritten in order to achieve compatibility with simulations in development at other ONR-funded institutions. Several improvements were made to deal with fidelity and operator interface considerations. The second major focus of our attention has been a program of basic research into mental factors that may affect the acquisition of spatial knowledge. Experiments were performed investigating the relationship

between imagined translations and imagined rotations, following results reported elsewhere in the literature. These results have implications for the structure of coordinate space in egocentric mental representations.
DTIC
Virtual Reality; Knowledge Based Systems; Education

20010056498 University of West Florida, Inst. for Human and Machine Cognition, Pensacola, FL USA
Cognitive Prostheses
Ford, Kenneth M., University of West Florida, USA; Workshop on Science and the Human Exploration of Mars; 2001, pp. 58; In English; See also 20010056494; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

This emerging concept of human-centered computing represents a significant shift in thinking about intelligent machines, and indeed about information technology in general. It embodies a ”systems view,” in which human thought and action and technological systems are seen as inextricably linked and equally important aspects of analysis, design, and evaluation. This framework focuses - less on stand-alone exemplars of mechanical cognitive talent and is concerned more with computational aids designed to amplify human cognitive and perceptual abilities. Essentially these are cognitive prostheses, computational systems that leverage and extend human intellectual capacities, just as the steam-shovel was a sort of muscular prosthesis. The prosthesis metaphor implies the importance of designing systems that fit the human and machine components together in ways that synergistically exploit their respective strengths. The design and fit of these computational prostheses require a broader interdisciplinary range than has traditionally been associated with AI work, including computer scientists, cognitive scientists, physicians, and social scientists of various stripes. This shift in perspective places human/machine interaction issues at the center of focus. The ”system” in question isn’t ”the computer” but instead includes cognitive and social systems, computational tools, and the physical facilities and environment. Thus, human-centered computing provides a new research outlook, with new research agendas and goals. Building cognitive prostheses is fundamentally different from AI’s traditional Turing Test ambitions - it doesn’t set out to imitate human abilities, but to extend them. As humans contemplate journeys to Mars and beyond, research requirements clearly exist for developing a wide range of performance support systems for both astronauts and ground operations personnel.
Author
Cognition; Artificial Intelligence

64
NUMERICAL ANALYSIS

Includes iteration, differential and difference equations, and numerical approximation.

20010054962 Universities Space Research Association, Hampton, VA USA
High Order Finite Difference and Finite Volume WENO Schemes and Discontinuous Galerkin Methods for CFD *Final Report*
Shu, Chi-Wang, Brown Univ., USA; May 2001; 21p; In English
Contract(s)/Grant(s): NAS1-97046; F49620-99-1-0077; NAG1-2070; DAAG55-97-1-0318; DAAD19-00-1-0405; NSF DMS-98-04985; NSF ECS-99-06606; RTOP 505-90-52-01
Report No.(s): NASA/CR-2001-210865; NAS 1.26:210865; ICASE-2001-11; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

In recent years high order numerical methods have been widely used in computational fluid dynamics (CFD) to effectively resolve complex flow features using meshes which are reasonable for today’s computers. In this paper we review and compare three types of high order methods being used in CFD. namely the weighted essentially lion-oscillatory (WENO) finite difference methods, the WENO finite. volume methods, and the discontinuous Galerkin (DG) finite element methods. We summarize the main features of these methods, from a practical user’s point of view, indicate their applicability and relative strength, and show a few selected numerical examples to demonstrate their performance on illustrative model CFD problems.
Author
Finite Difference Theory; Finite Volume Method; Galerkin Method; Computational Fluid Dynamics

20010055429 Industrial Technology Research Inst., Center for Aviation and Space Technology, Hsinchu, Taiwan, Province of China
The Positive Real Control Problem and the Generalized Algebraic Riccati Equation for Descriptor Systems
Wang, He-Sheng, Industrial Technology Research Inst., Taiwan, Province of China; Yung, Chee-Fai, National Taiwan Ocean

Univ., Taiwan, Province of China; Chang, Fan-Ren, National Taiwan Univ., Taiwan, Province of China; Journal of the Chinese Institute of Engineers; March 2001; ISSN 0253-3839; Volume 24, No. 2, pp. 203-220; In English; Copyright; Avail: Issuing Activity

In this paper, some useful properties of generalized algebraic Riccati equations and generalized positive real lemma for descriptor systems are given, Based on these results, the main purpose of this paper is to investigate the positive real (PR) control problem for descriptor systems. Necessary and sufficient conditions are derived for the solution to this problem expressed in terms of two generalized algebraic Riccati equations which may be considered to be generalizations of the Riccati equations obtained by Sun et al. (1994). When these conditions hold, state space formulae for all controllers solving the problem are also given.
Author

Algebra; Riccati Equation

20010055660 Tunghai Univ., Dept. of Computer Science and Information Engineering, Taichung, Taiwan, Province of China

A Binomial Tree Based Parallel Load-Balancing Method for Solution-Adaptive Finite Element Graphs on Distributed Memory Multicomputers

Chu, William C., Tunghai Univ., Taiwan, Province of China; Yang, Don-Lin, Feng Chia Univ., Taiwan, Province of China; Liao, Ching-Jung, Feng Chia Univ., Taiwan, Province of China; Chung, Yeh-Ching, Feng Chia Univ., Taiwan, Province of China; Journal of the chinese Institute of Engineers; March 2001; ISSN 0253-3839; Volume 24, No. 2, pp. 187-202; In English; Copyright; Avail: Issuing Activity

In this paper, we propose a binomial tree based parallel load-balancing method (BINOTPLB) to deal with the load imbalance of solution-adaptive finite element application programs on distributed memory multicomputers. The main idea of the BINOTPLB method is first to construct a binomial tree based condensed processor graph. Based on the condensed processor graph, a prefix code tree is built. From the prefix code tree, a schedule for performing load transfer among processors can be determined by concurrently and recursively dividing the prefix code tree into two subtrees and finding a maximum matching for processors in the two subtrees until the leaves are reached. Since each leaf is a binomial tree and a binomial tree can also be divided into two equal halves of binomial trees, the approach used to determine the schedule of a prefix code tree could also be applied to the binomial trees. We have implemented the BINOTPLB method on an SP2 parallel machine and compared its performance with two load-balancing methods, the directed diffusion method and the multilevel diffusion method, and three mapping methods, the JOSTLE-MS method, the MLkP method, and the PARTY library method. Three criteria, the execution time of mapping/load-balancing methods, the execution time of an application program under different mapping/load-balancing methods, and the speedups achieved by mapping/load-balancing methods for an application program, are used for the performance evaluation. The experimental results show that the BINOTPLB method outperforms other methods for most of test samples.
Author

Binomials; Trees (Mathematics); Balancing; Loads (Forces)

20010059305 Institute for Computer Applications in Science and Engineering, Hampton, VA USA

Semicoarsening and Implicit Smoothers for the Simulation of a Flat Plate at Yaw ***Final Report***

Montero, Ruben S., Universidad Complutense, Spain; Llorente, Ignacio M., Universidad Complutense, Spain; Salas, Manuel D., Institute for Computer Applications in Science and Engineering, USA; May 2001; 22p; In English; Original contains color illustrations

Contract(s)/Grant(s): NAS1-97046; RTOP 505-90-52-01

Report No.(s): NASA/CR-2001-210871; NAS 1.26:210871; ICASE-2001-13; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This paper presents a full multigrid solver for the simulation of flow over a yawed flat plate. The two problems associated with this simulation; boundary layers and entering flows with non-aligned characteristics, have been successfully overcome through the combination of a plane-implicit solver and semicoarsening. In fact, this multigrid algorithm exhibits a textbook multigrid convergence rate, i.e., the solution of the discrete system of equations is obtained in a fixed amount of computational work, independently of the grid size, grid stretching factor and non parameter. Also, a parallel variant of the smoother based on a four-color ordering of planes is investigated.
Author

Smoothing; Yaw; Flat Plates; Simulation; Boundary Layers

65
STATISTICS AND PROBABILITY

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

20010054611 Pennsylvania State Univ., Center for Multivariate Analysis, University Park, PA USA
Shape and Image Analysis using Neural Networks Fractals and Wavelets ***Final Report, 1 Apr. 1996 - 31 Mar. 2000***
Rao, C. R., Pennsylvania State Univ., USA; Kumara, S. R., Pennsylvania State Univ., USA; May 07, 2000; 55p; In English
Contract(s)/Grant(s): DAAH04-96-1-0082
Report No.(s): AD-A388833; ARO-35518.63-MA; No Copyright; Avail: CASI; A01, Microfiche; A04, Hardcopy

A general theory and appropriate statistical analysis are developed for discrimination of objects by shape, i.e., by using features which are invariant to location, scale and orientation, in particular to reflection also. In the case of landmark data, features such as Euclidean distances between landmarks or angles of triangles after suitable triangulation are considered. When the objects do not have recognizable landmarks, as in the case of closed boundaries, we can use topological properties of points on the boundary at intervals of constant length as features. to deal with such cases, a new geometry of circular vectors with a suitably defined metric is developed. This enables the use of distance methods such as k-NN rule in pattern recognition. We have also concentrated on the extraction of features for representing shapes. As a generalization we have considered the signals from machining process and studied characterization using chaos and fractal analysis. We extended this work to represent shapes using wavelets, Fourier descriptors, fractal image compression and iterated functional systems. We have conducted a comparative analysis. In the contemporary internet world search engines need sophisticated techniques to search for images of interest based on shapes. We proposed a preliminary model and web bot based upon our shape analysis study to develop an image search engine for the www.
DTIC
Image Processing; Pattern Recognition; Neural Nets; Fractals; Image Analysis; Shapes; Multivariate Statistical Analysis

67
THEORETICAL MATHEMATICS

Includes algebra, functional analysis, geometry, topology set theory, group theory and and number theory.

20010059941 Massachusetts Inst. of Tech., Cambridge, MA USA
Moduli for Pairs of Elliptic Curves With Isomorphic N-Torsion ***Final Report, 1 Sep. 1994 - 31 May 1998***
Carlton, David; Jun. 1998; 55p; In English
Contract(s)/Grant(s): DAAH04-94-G-0299
Report No.(s): AD-A388911; ARO-33547.1-RT-NDF; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

We study the moduli surface for pairs of elliptic curves together with an isomorphism between their N-torsion groups. The Weil pairing gives a ”determinant” map from this moduli surface to ?Z/NZ): its fibres are the components of the surface. We define spaces of modular forms on these components and Hecke correspondences between them and study how those spaces of modular forms behave as modules for the Hecke algebra. We discover that the component with determinant -1 is somehow the ”dominant” one; we characterize the difference between its spaces of modular forms and the spaces of modular forms on the other components using forms with complex multiplication. Finally, we show some simplifications that arise when N is prime, including a complete determination of such CM-forms. and give numerical examples.
DTIC
Number Theory; Analysis (Mathematics)

70
PHYSICS (GENERAL)

Includes general research topics related to mechanics, kinetics, magnetism, and electrodynamics. For specific areas of physics see categories 71 through 77. For related instrumentation see 35 Instrumentation and Photography; for geophysics, astrophysics or solar physics see 46 Geophysics, 90 Astrophysics, or 92 Solar Physics.

20010055577 FROM
Hyperbolicity of Renormalization of Critical Circle Maps
Yampolsky, M.; Jul. 2000; 38p; In English
Report No.(s): PB2001-105067; IHES/M/00/50; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
The authors settle the long-standing Hyperbolicity Conjecture for renormalization of critical circle maps, which implies universality. The authors' main tool is a new renormalization transformation, the cylinder renormalization, which can be extended to a complex-analytic operator on a Banach manifold of maps.
NTIS
Analytic Functions; Manifolds (Mathematics)

20010055580 FROM
Homological Mirror Symmetry and Torus Fibrations
Kontsevich, M.; Soibelman, Y.; Jan. 2001; 68p
Report No.(s): PB2001-105058; IHES/M/01/01; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche
The mirror symmetry is a duality between Calabi-Yau manifolds, i.e., complex manifolds with Kahler metrics with vanishing Ricci curvature. In fact, it is rather duality not between individual manifolds, but between manifolds in certain 'degenerating' families ('large complex structure limit' and 'large symplectic structure limit'). In this paper we propose some conjectures of differential-geometric nature about the degenerations. In particular, we assume that in the limit both dual manifolds X and X(sub v) become fiber bundles with toroidal fibers over the same base Y. The manifold Y is a (real) Riemannian manifold whose dimension is half of the dimension of X and X(sub v). Also, manifold Y carries a rich geometric structure which contains as a part a 'combinatorial' data, so-called integral affine structure.
NTIS
Symmetry; Toruses; Manifolds (Mathematics)

20010055581 FROM
Quantum Tori, Mirror Symmetry and Deformation Theory
Soibelman, Y.; Dec. 2000; 42p
Report No.(s): PB2001-105057; IHES/M/00/84; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
Mathematical models of dualities in quantum physics is a very interesting and intriguing area of research. The purpose of this paper is to explain without details the idea of non-commutative compactification in the example of abelian varieties.
NTIS
Toruses; Manifolds (Mathematics); Deformation

20010058722 Fermi National Accelerator Lab., Batavia, IL USA
Effect of Dividing the Magnets on the Calculation of a Recycler Dynamic Aperture
Gelfand, N.; May 04, 2001; 22p; In English
Report No.(s): PB2001-106022; FERMILAB/TM-2143; No Copyright; Avail: National Technical Information Service (NTIS)
The modeling of a lattice and the calculation of the dynamic aperture, are exercises fraught with uncertainty and possible error. If we want an accurate value for the dynamic aperture, we must start with an accurate model for the lattice. This model should incorporate the misalignments, including the rolls, of the lattice elements, as well as the error fields in the magnets. These quantities are not always well known. It has been known for sometime that long term tracking must be symplectic. This means that either we utilize a code like MARYLIE which employs a Lie algebraic approach, or a code that employs zero length kicks for the non-linear parts of the magnetic fields. Calculation of the dynamic aperture of the Recycler is particularly difficult because of the large intrinsic sextupole built into gradient magnets. A recent attempt to calculate the dynamic aperture for the Recycler Ring has used MAD. Originally the calculation was done with the magnets treated, as they exist, as single objects. The result was

a dynamic aperture of 3:0 sigma. The calculation was redone with the magnets split into 16 segments and the result was a dynamic aperture of 9.5 sigma. This report is an attempt to understand the reason for the difference in these two calculations.
NTIS
Magnets; Apertures; Lattices (Mathematics)

20010058867 Princeton Univ., Plasma Physics Lab., NJ USA
Effects of Finite Density Fluctuations and of the Upper Hybrid Resonance on O-X Correlation Reflectometry
Kramer, G. J.; Nazikian, R.; Valeo, E.; Feb. 2001; 24p; In English
Report No.(s): PB2001-105600; PPPL-3544; No Copyright; Avail: National Technical Information Service (NTIS)

The correlation between O-mode and X-mode reflectometer signals is studied wit a 1D reflectometer model taking into account the influence of finite density fluctuation levels and the upper hybrid resonance. It is found that a high level of O-X correlation can only be achieved for sufficiently small density fluctuation levels (typically much less than 1%) or very low magnetic yield strengths. The influence of the upper hybrid resonance on the O-X correlation was found to also degrade the correlation between the O and X mode signals for very low magnetic yield strengths or for very short density scale lengths. The extrapolation of these results to reactor scale parameters indicates that the magnetic yield strength can reliably be measured in the core plasma provided the density fluctuation level is typically much less than 1%.
NTIS
Reflectometers; Correlation; Density Measurement

20010059602 California Univ., Santa Barbara, CA USA
The Physics of Boiling at Burnout
Theofanous, T. G., California Univ., USA; Tu, J. P., California Univ., USA; Dinh, T. N., California Univ., USA; Salmassi, T., California Univ., USA; Dinh, A. T., California Univ., USA; Gasljevic, K., California Univ., USA; [2000]; 10p; In English; International Conferece on Multiphase Systems (JCMS'2000), 15-17 Jun. 2000, Ufa, Russia
Contract(s)/Grant(s): NRC-04-98-051; NAG3-2119; RTOP 101-43-0B; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The basic elements of a new experimental approach for the investigation of burnout in pool boiling are presented. The approach consists of the combined use of ultrathin (nano-scale) heaters and high speed infrared imaging of the heater temperature pattern as a whole, in conjunction with highly detailed control and characterization of heater morphology at the nano and micron scales. It is shown that the burnout phenomenon can be resolved in both space and time. Ultrathin heaters capable of dissipating power levels, at steady-state, of over 1 MW/square m are demonstrated. A separation of scales is identified and it is used to transfer the focus of attention from the complexity of the two-phase mixing layer in the vicinity of the heater to a micron-scaled microlayer and nucleation and associated film-disruption processes within it.
Author
Boiling; Burnout; Heat Transfer; Cooling; Heat Exchangers; Vapors; Water Heating

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ACOUSTICS

Includes sound generation, transmission, and attenuation. For noise pollution see 45 Environment Pollution. For aircraft noise see also 02 Aerodynamics and 07 Aircraft Propulsion Propulsion and Power.

20010055658 Feng Chia Univ., Dept. of Mechanical Engineering, Taichung, Taiwan, Province of China
Performance Analysis of Guided Noise Cancellation
Hsiao, Chao-Yin, Feng Chia Univ., Taiwan, Province of China; Teng, Chin-Kun, Feng Chia Univ., Taiwan, Province of China; Lee, Tsung-Yu, Feng Chia Univ., Taiwan, Province of China; Journal of the Chinese Institute of Engineers; March 2001; ISSN 0253-3839; Volume 24, No. 2, pp. 261-268; In English
Contract(s)/Grant(s): NSC 89-2213-E-035-037; Copyright; Avail: Issuing Activity

This paper shows some fundamental study results from the guided noise cancellation technique. Special emphasis is placed on the noise cancellation capability of both series and parallel systems on periodical input sound waves. Theoretically, in each stage, a series noise cancellation system can cancel the fundamental wave and all the odd harmonic waves completely, while a

k-phase parallel noise cancellation system can cancel the fundamental and all the harmonic terms except the k-th, 2k-th, 3k-th,... terms. We also present the experimental results for showing the feasibility of this approach.
Author
Reliability Analysis; Performance Prediction; Noise (Sound)

20010057034 NASA Langley Research Center, Hampton, VA USA
Comparison of Two Acoustic Waveguide Methods for Determining Liner Impedance
Jones, Michael G., NASA Langley Research Center, USA; Watson, Willie R., NASA Langley Research Center, USA; Tracy, Maureen B., NASA Langley Research Center, USA; Parrott, Tony L., NASA Langley Research Center, USA; [2001]; 10p; In English; 7th AIAA/CEAS Aeroacoustics Conference, 28-30 May 2001, Maastricht, Netherlands; Sponsored by American Inst. of Aeronautics and Astronautics, USA; Original contains color illustrations
Report No.(s): AIAA Paper 2001-2266; Copyright Waived; Avail: CASI; A02, Hardcopy; A01, Microfiche

Acoustic measurements taken in a flow impedance tube are used to assess the relative accuracy of two waveguide methods for impedance eduction in the presence of grazing flow. The aeroacoustic environment is assumed to contain forward and backward-traveling acoustic waves, consisting of multiple modes, and uniform mean flow. Both methods require a measurement of the complex acoustic pressure profile over the length of the test liner. The Single Mode Method assumes that the sound pressure level and phase decay-rates of a single progressive mode can be extracted from this measured complex acoustic pressure profile. No a priori assumptions are made in the Finite Element. Method regarding the modal or reflection content in the measured acoustic pressure profile. The integrity of each method is initially demonstrated by how well their no-flow impedances match those acquired in a normal incidence impedance tube. These tests were conducted using ceramic tubular and conventional perforate liners. Ceramic tubular liners were included because of their impedance insensitivity to mean flow effects. Conversely, the conventional perforate liner was included because its impedance is known to be sensitive to mean flow velocity effects. Excellent comparisons between impedance values educed with the two waveguide methods in the absence of mean flow and the corresponding values educed with the normal incident impedance tube were observed. The two methods are then compared for mean flow Mach numbers up to 0.5, and are shown to give consistent results for both types of test liners. The quality of the results indicates that the Single Mode Method should be used when the measured acoustic pressure profile is clearly dominated by a single progressive mode, and the Finite Element Method should be used for all other cases.
Author
Accuracy; Waveguides; Pressure Distribution; Linings; Sound Pressure; Impedance Measurement

20010057067 NASA Langley Research Center, Hampton, VA USA
Time-Accurate Simulations and Acoustic Analysis of Slat Free-Shear Layer
Khorrami, Mehdi R., NASA Langley Research Center, USA; Singer, Bart A., NASA Langley Research Center, USA; Berkman, Mert E., High Technology Corp., USA; [2001]; 14p; In English; 7th AIAA/CEAS Aeroacoustics Conference, 28-30 May 2001, Maastricht, Netherlands; Sponsored by American Inst. of Aeronautics and Astronautics, USA
Contract(s)/Grant(s): NAS1-20102; RT46324
Report No.(s): AIAA Paper 2001-2155; Copyright Waived; Avail: CASI; A03, Hardcopy; A01, Microfiche

A detailed computational aeroacoustic analysis of a high-lift flow field is performed. Time-accurate Reynolds Averaged Navier-Stokes (RANS) computations simulate the free shear layer that originates from the slat cusp. Both unforced and forced cases are studied. Preliminary results show that the shear layer is a good amplifier of disturbances in the low to mid-frequency range. The Ffowcs-Williams and Hawkings equation is solved to determine the acoustic field using the unsteady flow data from the RANS calculations. The noise radiated from the excited shear layer has a spectral shape qualitatively similar to that obtained from measurements in a corresponding experimental study of the high-lift system.
Author
Acoustic Measurement; Aeroacoustics; Shear Layers; Unsteady Flow; Computerized Simulation

20010057625 Montana State Univ., Dept. of Chemistry, Bozeman, MT USA
Electron Transfer Chemistry in Optical Materials: An EPR Investigation of Radiation-Induced Defects in Chemically Modified Materials ***Final Report, 1 Sep. 1996-31 Aug. 2000***
Singel, David J., Montana State Univ., USA; Jan. 15, 2001; 107p; In English
Contract(s)/Grant(s): F49620-96-1-0443
Report No.(s): AD-A389195; AFRL-SR-BL-TR-01-0278; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

The Final Technical Report ”Electron Transfer Chemistry in Optical Materials: an EPR Investigation of Radiation-Induced Defects in Chemically Modified Materials” details the construction, and performance-evaluation of a 94.9 GHz EPR (electron

paramagnetic resonance) spectrometer, operating in both CW (continuous wave) and pulsed modes. The first application of this instrument in the study of radiation induced defects in optical materials; a neutron-irradiated alpha-Al2O3 single crystal fiber, and gamma-irradiated of vitreous silica samples; are also described. A major finding of this work is that, owing to excellent sensitivity for volume-limited samples, high-frequency EPR instrumentation makes it possible to characterize paramagnetic centers in optical fibers. This capability is illustrated by reported spectroscopic, line shape, and analytical studies of Cr(3+), Fe(3+), and color centers (electrons trapped at anion vacancies) at ppm levels in an alpha-Al2O3 fiber. Special characteristics of high-magnetic fields for improving and facilitating EPR spectroscopy and analysis (spin-counting) are detailed. An emergent feature of high-frequency EPR spectroscopy is the apparent ease of eliciting saturation and rapid passage effects. Pioneering efforts in the systematic characterization and theoretical simulation of these effects are reported. Preliminary results suggest that passage effects can be harnessed to provide enhanced sensitivity and pronounced relaxation-dependent selectivity in the EPR spectroscopy.
DTIC
Electron Paramagnetic Resonance; Electron Transfer

20010058886 NASA Langley Research Center, Hampton, VA USA
Analysis of Measured and Predicted Acoustics From an XV-15 Flight Test
Boyd, D. Douglas, Jr., NASA Langley Research Center, USA; Burley, Casey L., NASA Langley Research Center, USA; [2001]; 42p; In English; American Helicopter Society 57th Forum, 9-11 May 2001, Washington, DC, USA; Sponsored by American Helicopter Society, Inc., USA; Original contains color illustrations; Copyright; Avail: Issuing Activity

Flight acoustic and vehicle state data from an XV-15 acoustic flight test are examined. Flight predictions using TiltRotor Aeroacoustic Code (TRAC) are performed for a level flight (repeated) and four descent conditions (including a blade vortex interaction (BVI)). The assumptions and procedures used for TRAC flight predictions as well as the variability in flight measurements, which are used for input and comparison to predictions, are investigated in detail. Differences were found in the measured vehicle airspeed, altitude, glideslope, and vehicle orientation (yaw, pitch, and roll angle) between each of the repeat runs. These differences violate some of the prediction assumptions and significantly impacted the resulting acoustic predictions. Multiple acoustic pulses, with a variable time between the pulses, were found in the measured acoustic time histories for the repeat runs. These differences could be attributed in part to the variability in vehicle orientation. Acoustic predictions that used the measured vehicle orientation for the repeat runs captured this multiple pulse variability. Thickness noise was found to be dominant on approach for all the cases, except the BVI condition. After the aircraft passed overhead, broadband noise and low frequency loading noise were dominant. The predicted LowSPL time histories compared well with measurement on approach to the array for the non-BVI conditions and poorly for the BVI condition. Accurate prediction of the lift share between the rotor and fuselage must be known in order to improve predictions. At a minimum, measurements of the rotor thrust and tip-path-plane angle are critical to further develop accurate flight acoustic prediction capabilities.
Author
Acoustic Properties; Flight Tests; Blade-Vortex Interaction; Aeroacoustics; Aircraft Noise

20010059039 NASA Glenn Research Center, Cleveland, OH USA
An Exact Form of Lilley's Equation with a Velocity Quadrupole/Temperature Dipole Source Term
Goldstein, Marvin E., NASA Glenn Research Center, USA; [2001]; 7p; In English; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

There have been several attempts to introduce approximations into the exact form of Lilley's equation in order to express the source term as the sum of a quadrupole whose strength is quadratic in the fluctuating velocities and a dipole whose strength is proportional to the temperature fluctuations. The purpose of this note is to show that it is possible to choose the dependent (i.e., the pressure) variable so that this type of result can be derived directly from the Euler equations without introducing any additional approximations.
Author
Differential Equations; Quadrupoles; Temperature Effects; Velocity; Approximation

20010059234 Taitech, Inc., Beavercreek, OH USA
Computational Aeroacoustics by the Space-Time CE/SE Method
Loh, Ching Y., Taitech, Inc., USA; [2000]; 59p; In English; 2nd Computational Aeroacoustics Workshop, 6-7 Oct. 2000, Germany; Sponsored by Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Germany
Contract(s)/Grant(s): NAS3-97186; RTOP 523-90-43; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

The Space-Time Conservation Element and Solution Element Method, or CE/SE Method for short, is a newly developed numerical method for conservation laws. Despite its second order accuracy, it possesses low dispersion errors and low dissipation. The method is robust enough to cover a wide spectrum of compressible flows: from weak linear acoustic waves to strong discontinuous waves (shocks). An outstanding feature of the CE/SE scheme is its novel, simple but effective non-reflecting boundary condition (NRBC), which is particularly valuable for CAA (computational aeroacoustics). In this seminar, the 1-D and 2-D unstructured version of the CE/SE schemes are first briefly described. Secondly, some discussions on the NRBC are given. Then, various examples for linear, nonlinear aeroacoustics are presented.
Author
Aeroacoustics; Sound Waves; Boundary Conditions; Conservation

20010059380 NASA Ames Research Center, Moffett Field, CA USA
NASA/ARMY/BELL XV-15 Tiltrotor Low-Noise Terminal Area Operations Flight Research Program
Edwards, Bryan D., Textron Bell Helicopter, USA; Conner, David A., Army Aviation and Missile Command, USA; Decker, William A., NASA Ames Research Center, USA; Marcolini, Michael A., NASA Langley Research Center, USA; Klein, Peter D., Textron Bell Helicopter, USA; [2001], pp. 00-08-1 - 00-08-23; In English; Tiltrotor/Runway Independent Aircraft Technology and Applications Specialists' Meeting, 20-21 Mar. 2001, Arlington, TX, USA; Sponsored by American Helicopter Society, Inc., USA; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

To evaluate the noise reduction potential for tiltrotor aircraft, a series of three XV- 15 acoustic flight tests were conducted over a five-year period by a NASA/Army/Bell Helicopter team. Lower hemispherical noise characteristics for a wide range of steady-state terminal area type operating conditions were measured during the Phase I test and indicated that the takeoff and level flight conditions were not significant contributors to the total noise of tiltrotor operations. Phase I results were also used to design low-noise approach profiles that were tested later during the Phase 2 and Phase 3 tests. These latter phases used large area microphone arrays to directly measure ground noise footprints. Approach profiles emphasized noise reduction while maintaining handling qualities sufficient for tiltrotor commercial passenger ride comfort and flight safety under Instrument Flight Rules (IFR) conditions. This paper will discuss the weather, aircraft, tracking, guidance, and acoustic instrumentation systems, as well as the approach profile design philosophy, and the overall test program philosophy. Acoustic results are presented to document the variation in tiltrotor noise due to changes in operating condition, indicating the potential for significant noise reduction using the unique tiltrotor capability of nacelle tilt. Recommendations are made for a final XV-15 test to define the acoustic benefits of the automated approach capability which has recently been added to this testbed aircraft.
Author
Flight Tests; Helicopters; Noise Reduction; XV-15 Aircraft; Tilt Rotor Research Aircraft Program; Aeroacoustics; Approach; Landing

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ATOMIC AND MOLECULAR PHYSICS

Includes atomic and molecular structure, electron properties, and atomic and molecular spectra. For elementary particle physics see 73 Nuclear Physics.

20010055699 Kyoto Univ., Faculty of Science, Japan
Low Mass Enhancement of K+K- Invariant Mass Measured in 12-GeV p+A Reactions
Ishino, Masaya, Kyoto Univ., Japan; Memoirs of the Faculty of Science, Kyoto University; 2001; ISSN 0368-9689; Volume 42, No. 1, Article 1, pp. 1-94; In English; Copyright; Avail: Issuing Activity

We have measured K+K- invariant mass spectra in 12-GeV p+A interaction with a newly constructed spectrometer at the primary beam line in KEK Proton-Synchrotron. The aim of the experiment was to detect in-medium modification of the phi meson, which is theoretically predicted as a consequence of partially-restored chiral-symmetry at normal nuclear-matter density. The spectrometer was designed to measure slowly moving phi mesons with beta-gamma(sub lab) from 1 to 3. Significant portion of such phi mesons will decay inside a nucleus, and the observed mass spectrum should be sensitive to the medium effect. The observed K+K- spectra show a clear peak of phi to K+K- decays. The kinematical distributions of the phi mesons are well reproduced by the nuclear cascade code JAM. Nuclear mass-number dependence of the phi production is determined to be A(sup 1.01 +/- 0.09), which is also consistent with the JAM simulation with a reasonable agreement in the absolute cross sections. In the K+K- spectra we have observed an enhancement below the phi peak where the dominant source in JAM is from decays of a(sub o)(980)/f(sub o)(980) mesons. We have determined the ratios of a(sub o)/f(sub o) to K+K- to phi to K+K- as 37.7 +/- 0.37% for the light nuclear targets (carbon and polyethylene) and 27.2 +/- 10.1% for the heavy nuclear targets (copper and gadlinium),

by allowing the scaling of the a(sub o)/f(sub o) production cross-section in JAM. The absence of nuclear size dependence in these ratios indicates such an enhancement can not be attributed to the in-media mass modification of the phi meson which should have a strong mass number dependence.
Author
Mesons; Mass Spectra; Synchrotrons; Mass Distribution

20010056298 NASA Goddard Space Flight Center, Greenbelt, MD USA
Resonances in Positronium Hydride
Drachman, Richard J., NASA Goddard Space Flight Center, USA; [2001]; 1p; In English; Positron Workshop 2001, 22-29 Jul. 2001, USA; No Copyright; Avail: Issuing Activity; Abstract Only

Recently, Ho and his colleagues have calculated the positions and widths of a series of resonances in the Ps+H scattering system, using the complex -rotation method and have compared them with estimates that I made many years ago using a quite different technique. I assumed that the resonance mechanism was the existence in the rearrangement channel [e+ + H-] of an infinite series of perturbed Coulomb bound states. Although these must be broadened and shifted by coupling with the open scattering channel, I expected them to lie very close to the actual resonance positions. to verify this, I did a model calculation for S-waves, including the coupling, and found that the first two resonances were not shifted very far from their unperturbed position. The new, detailed calculation agrees with this result, but when the P-wave was examined it was found, surprisingly, that the lowest resonance indeed moved up in energy by a large amount. With the help of Joseph DiRienzi of the College of Notre Dame of Maryland I am now extending the old calculation to P- and D-waves, in an attempt to understand this unexpected energy shift. Results will be presented at the Workshop.
Author
Positronium; Hydrides; Estimates; Resonance

20010057259 NASA Johnson Space Center, Houston, TX USA
Radiation Transmission Properties of In-Situ Materials
Heilbronn, L., California Univ., Lawrence Berkeley Lab., USA; Townsend, L. W., Tennessee Univ., USA; Cucinotta, F., NASA Johnson Space Center, USA; Kim, M. Y., NASA Langley Research Center, USA; Miller, J., California Univ., Lawrence Berkeley Lab., USA; Singleterry, R., NASA Langley Research Center, USA; Thibeault, S., NASA Langley Research Center, USA; Wilson, J., NASA Langley Research Center, USA; Zeitlin, C. J., California Univ., Lawrence Berkeley Lab., USA; Microgravity Materials Science Conference 2000; March 2001; Volume 2, pp. 295-300; In English; See also 20010057256; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A02, Hardcopy

The development of a permanent human presence in space is a key element of NASA's strategic plan for the Human Exploration and Development of Space (HEDS). The habitation of the International Space Station (ISS) is one near-term HEDS objective; the exploration and settlement of the moon and Mars are long-term goals of that plan. Achieving these goals requires maintaining the health and safety of personnel involved in such space operations at a high level, while at the same time reducing the cost of those operations to a reasonable level. Among the limiting factors to prolonged human space operations are the health risks from exposure to the space ionizing radiation environment. In order to keep the risk of radiation induced cancer at acceptable levels, it is necessary to provide adequate shielding from the ionizing radiation environment. The research presented here is theoretical and ground-based experimental study of the neutron production from interactions of GCR-like particles in various shielding components. An emphasis is placed here on research that will aid in the development of in-situ resource utilization. The primary goal of the program is to develop an accurate neutron-production model that is relevant to the NASA HEDS program of designing technologies that will be used in the development of effective shielding countermeasures. A secondary goal of the program is the development of an experimental data base of neutron production cross sections and thick-target yields which will aid model development.
Derived from text
Manned Space Flight; Health; Radiation Shielding; Data Bases; Extraterrestrial Radiation

20010057295 Polytechnic Univ., Dept. of Chemical Engineering, Brooklyn, NY USA
Statistical Studies of Heterogeneous and Homogeneous Nucleation
Izmailov, A. F., Polytechnic Univ., USA; Zaccaro, J., Centre National de la Recherche Scientifique, France; Myerson, A. S., Illinois Inst. of Tech., USA; Microgravity Materials Science Conference 2000; March 2001; Volume 2, pp. 447-448; In English; See also 20010057256; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A01, Hardcopy

The objective of our study is to build experimental means as well as theoretical treatment allowing discrimination of heterogeneous and homogeneous, primary and secondary nucleation in solutions. Any success in this direction is of paramount importance in planning and controlling microgravity experiments in space. Primary nucleation is a complex stochastic phenomenon. In the general case its stochastic nature is contributed by at least two independent stochastic sources: 1) Density fluctuations in a metastable (supersaturated) state. These fluctuations are intrinsic to the metastable state of matter and eventually lead to homogeneous nucleation given there are no heterogeneities present. 2) Presence of randomly distributed micro- and macro-heterogeneities in a supersaturated solution. Nucleation on these heterogeneities is known as heterogeneous nucleation. Therefore, due to the stochastic nature of nucleation, the only way to study nucleation is to gather its sufficient statistics. In the case of solutions both solute density fluctuations and heterogeneities contribute primary nucleation that results in the birth of solute nuclei. These nuclei themselves might serve as centers of another nucleation phenomenon - secondary nucleation. In order to discriminate all these different types of nucleation it Is important to experimentally reproduce homogeneous nucleation and to have means to discriminate it from the heterogeneous nucleation. The heterogeneous nucleation alone has been intensively studied in bulk solutions for years. The homogeneous nucleation in ground-based experiments can be achieved employing the Electrodynamic Levitator Trap (ELT) technique (see description of the technique in. This unique technique allows containerless levitation of a solution microdrop in a chamber with controlled humidity of solvent (water) vapor. The graduate evaporation of water vapor brings the microdroplet through a sequence of states with increasing supersaturation. As it has been demonstrated in our numerous experiments, supersaturations achievable in solution inside of a levitated solution microdroplet are usually 30-100 times higher than the maximum supersaturations reported ever for the same solutes in bulk solutions. This alone strongly indicates that nucleation observed in levitated solution microdroplets is homogeneous. In order to gather sufficient nucleation statistics it is required to repeat exactly the same nucleation experiment many times. The ELT technique provides this opportunity due to: 1) capability to produce virtually identical microdroplets (1 part per 10 (exp 3) is size and 1 part per 10(exp 3) in electric charge); 2) automation of the evaporation and deliquescence processes. The quantity measured in these virtually identical experiments is induction (lag) time. This time is a stochastic quantity the probability density (distribution) of which is intrinsically related to and derived from the physics of underlying fluctuations of solute density. In this study we report induction time statistics obtained with microdroplets of ammonium sulfate aqueous solution. We have measured 91 induction times obtained on the base of 16 virtually identical microdroplets. Each microdroplet was processed through consecutive evaporation - deliquescence cycle at least five times. The relative humidity adopted in these experiments was kept constant as close as possible: it always was within the range of 38.5% - 40% or better. The plot below represents the uncrystallized fraction of 91 runs versus time elapsed. It is obvious that the experimental curve consists of at least two well distinguishable exponents with transition time at around 10 minutes. It is natural to ascribe the first exponent, corresponding to shorter induction times, to heterogeneous nucleation, whereas the second one is most likely due to homogeneous nucleation.

Author

Nucleation; Heterogeneity; Gravitational Effects; Levitation; Metastable State; Microgravity; Stochastic Processes; Solutes; Solvents

20010057333 NASA Langley Research Center, Hampton, VA USA

Improved Spacecraft Materials for Radiation Protection

Wilson, John W., NASA Langley Research Center, USA; Cucinotta, Francis A., NASA Johnson Space Center, USA; Tripathi, Ram K., NASA Langley Research Center, USA; Clowdsley, M. S., NASA Langley Research Center, USA; Shinn, J. L., NASA Langley Research Center, USA; Singleterry, Robert C., Jr., NASA Langley Research Center, USA; Thibeault, Sheila Ann, NASA Langley Research Center, USA; Kim, M.-H. Y., College of William and Mary, USA; Heinbockel, John H., Old Dominion Univ., USA; Badhwar, Gautam D., NASA Johnson Space Center, USA; Microgravity Materials Science Conference 2000; March 2001; Volume 3, pp. 648-655; In English; See also 20010057302; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A02, Hardcopy

Methods by which radiation shielding is optimized need to be developed and materials of improved shielding characteristics identified and validated. The galactic cosmic rays (GCR) are very penetrating and the energy absorbed by the astronaut behind the shield is nearly independent of shield composition and even the shield thickness. However, the mix of particles in the transmitted beam changes rapidly with shield material composition and thickness. This results in part from the breakup of the high-energy heavy ions of the GCR which make contributions to biological effects out of proportion to their deposited energy. So the mixture of particles in the radiation field changes with shielding and the control of risk contributions from dominant particle types is critical to reducing the hazard to the astronaut. The risk of biological injury for a given particle type depends on the type of biological effect and is specific to cell or tissue type. Thus, one is faced with choosing materials which may protect a given tissue against a given effect but leave unchanged or even increase the risk of other effects in the same tissue or increase the risks to other adjacent tissues of a different type in the same individual. The optimization of shield composition will then be tied to a specific

tissue and risk to that tissue. Such peculiarities arise from the complicated mixture of particles, the nature of their biological response, and the details of their interaction with material constituents. Aside from the understanding of the biological response to specific components, one also needs an accurate understanding of the radiation emerging from the shield material. This latter subject has been a principal element of this project. In the past ten years our understanding of space radiation interactions with materials has changed radically, with a large impact on shield design. For example, the NCRP estimated that only 2 g/sq cm. of aluminum would be required to meet the annual 500 mSv limit for the exposure of the blood forming organs (this limit is strictly for LEO but can be used as a guideline for the Mars mission analysis). The current estimates require aluminum shield thicknesses above 50 g/sq cm., which is impractical. In such a heavily shielded vehicle, the neutrons produced throughout the vehicle also contribute significantly to the exposure and this demands greater care in describing the angular dependence of secondary particle production processes. As such the continued testing of databases and transport procedures in laboratory and spaceflight experiments has continued. This has been the focus of much of the last year's activity and has resulted in improved neutron prediction capability. These new methods have also improved our understanding of the surface environment of Mars. The Mars 2003 NRA HEDS related surface science requirements were driven by the need to validate predictions on the upward flux of neutrons produced in the Martian regolith and bedrock made by the codes developed under this project. The codes used in the surface environment definition are also being used to look at in situ resources for the development of construction material for Martian surface facilities. For example, synthesis of polyimides and polyethylene as binders of regolith for developing basic structural elements has been studied and targets built for accelerator beam testing of radiation shielding properties. Preliminary mechanical tests have also been promising. Improved spacecraft materials have been identified (using the criteria reported by this project at the last conference) as potentially important for future shielding materials. These are liquid hydrogen, hydrogenated nanofibers, liquid methane, LiH, Polyethylene, Polysulfone, and Polyetherimide (in order of decreasing shield performance). Some of the materials are multifunctional and are required for other onboard systems. We are currently preparing software for trade studies with these materials relative to the Mars Reference Mission as required in the project's final year.
Author
Radiation Protection; Radiation Shielding; Heavy Ions; Aluminum; Liquefied Gases

20010057336 NASA Langley Research Center, Hampton, VA USA
Measurement of Charged Particle Interactions in Spacecraft and Planetary Habitat Shielding Materials
Zeitlin, C., California Univ., Lawrence Berkeley Lab., USA; Heilbronn, Lawrence H., California Univ., Lawrence Berkeley Lab., USA; Miller, Jack W., California Univ., Lawrence Berkeley Lab., USA; Singleterry, Robert C., Jr., NASA Langley Research Center, USA; Wilson, John W., NASA Langley Research Center, USA; Microgravity Materials Science Conference 2000; March 2001; Volume 3, pp. 664-665; In English; See also 20010057302; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A01, Hardcopy

The Microgravity Materials Program, through its 98-HEDS-04 Research Announcement, has called for research to support 'enhanced human radiation protection through the development of light weight soft goods with high radiation protection characteristics.' Given the nature of the particle flux from the Galactic Cosmic Radiation (GCR), and the many constraints on the depth and type of shielding in spacecraft and planetary habitats, it is clear that the health risks these particles present to astronauts in deep space cannot be entirely eliminated. It is the objective of this project to develop a highly accurate model of GCR transport so that NASA can develop and validate the properties of protective shielding materials with the best available information. The validity of the GCR transport model depends in large part on having accurate and precise input data in the form of the charge-changing and fragment production cross sections for the heavy ions of greatest biological significance. The accuracy of the transport model can be evaluated and enhanced by employing the following a three-step strategy: (1) New cross section data will be made available to the NASA-Langley scientists responsible for the transport codes, and will be used as inputs to the codes; (2) The codes will be used to predict additional cross sections and/or details of the radiation field behind realistic shielding arrangements, where the materials and configurations may be quite complex. Mock-ups of the shielding configurations suitable for use in accelerator experiments will obtained by the NASA-Langley co-investigators; and (3) The transport model predictions will be tested in accelerator-based experiments. The time scale for one pass through these steps is well-suited to a four-year schedule. Over a longer term, these steps may be repeated, leading to still further refinements of the transport code, new predictions, and an additional round of measurements, until the desired predictive accuracy is achieved. The focus of this work is primarily on the first of these steps, the determination of fragmentation cross sections, which will be the main task in years one and two. The detailed strategy for carrying out the remainder of the program is more difficult to specify, as it depends on unpredictable factors such as the extent to which the transport model must be modified, schedules for accelerator time, target fabrication, etc.
Derived from text
Microgravity; Charged Particles; Particle Interactions; Shielding; Radiation Protection; Radiobiology; Cosmic Rays

20010057609 Harvard Univ., Dept. of Physics, Cambridge, MA USA
CDF Run I Beta Physics Results
Bailey, S.; Mar. 2001; 14p; In English; Original contains color illustrations
Report No.(s): PB2001-105433; FERMILAB-Conf-01/023-E; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Over the past decade, the Collider Detector at Fermilab (CDF) collaboration has produced many precision B physics measurements through its extremely successful B physics program. Nearly 50 B physics papers have been pub- lished and several more are in process. The primary advantages of hadron machines for B physics are twofold: a large b quark production cross section combined with the ability to produce all forms of b mesons and baryons. The primary disadvantage is that the cross section for generic QCD background is even larger than the b production cross section. Over the course of Run I CDF capitalized upon the advantages and overcame the disadvantages to produce many precision measurements across a wide variety of B physics topics. An overview of these results is presented in section 2, while section 3 focuses on a few recent results. Conclusions are given in section 4.
NTIS
Particle Accelerators; Quantum Chromodynamics; Particle Decay; Elementary Particles

20010058869 Brookhaven National Lab., Physics Dept., Upton, NY USA
Muon Sources
Parsa, Z.; Feb. 2001; 16p; In English; Presented at AIP Conference Proc. 549, 'Intersection of Particle and Nuclear Physics', 22-28 May 2000, Quebec City, Canada
Report No.(s): PB2001-105606; BNL-68141; No Copyright; Avail: National Technical Information Service (NTIS)

A full high energy muon collider may take considerable time to realize. However, intermediate steps in its direction are possible and could help facilitate the process. Employing an intense muon source to carry out forefront low energy research, such as the search for muon - number non - conservation, represents one interesting possibility. We present an overview of muon sources and example of a muon storage ring based Neutrino Factory at BNL with various detector location possibilities.
NTIS
Muons; Industrial Plants; Energy Technology; Storage Rings (Particle Accelerators)

20010058872 Fermi National Accelerator Lab., Batavia, IL USA
Standard Model Higgs Combined Result from CDF
Jan. 2001; 8p; In English
Report No.(s): PB2001-105611; FERMILAB-CONF-01/002-E; No Copyright; Avail: National Technical Information Service (NTIS)

The Tevatron is expected to be most sensitive to the Standard Model Higgs in the associated production with a W or Z boson. The Collider Detector at Fermilab (CDF) has performed individual searches for such production in each decay channel of the vector boson. These searches use data collected by CDF during the 1922-95 run. The individual results are reviewed and a combined cross section limit is presented.
NTIS
Particle Accelerators; Higgs Bosons; Standard Model (Particle Physics)

20010058873 National Science Center, Inst. for Theoretical Physics, Kharkov, Ukraine
Stochastic Resonance in a Periodically Modulated Dissipative Nuclear Dynamics
Berezovoj, B. P.; Bolotin, Y. L.; Dzyubak, O. P.; Zhiglo, A. V.; Jan. 2001; 12p; In English
Report No.(s): PB2001-105612; RERMILAB-CONF-01/009-T; No Copyright; Avail: National Technical Information Service (NTIS)

Since its discovery, the atomic nucleus has been constantly used for verifying of new physical ideas such as tunneling, superfluids, superconductivity, supersymmetry, and dynamical chaos. Thus it seems unnatural that one of the most recent and intriguing discoveries in nonlinear physics-stochastic resonance until now have not found response of the nuclear community. This is particularly odd because there is no doubt that the theory of the collective nuclear motion pretending on a consistent description of nuclear dynamics must be essentially nonlinear theory. The aim of the present work is to demonstrate the principle possibility of observation of stochastic response in nuclear dynamics. As a concrete example we consider a process of induced nuclear fission in the presence of weak periodic pertubation.
NTIS
Stochastic Processes; Nuclear Fission

20010058879 Los Alamos National Lab., NM USA
Simulation of Nuclear Analytical Chemistry Operations
Burnside, R. J.; DeMuth, N.; Kornreich, D. E.; 2001; 14p; In English
Report No.(s): PB2001-105669; LA-UR-00-2921; No Copyright; Avail: National Technical Information Service (NTIS)

This paper describes the objected-oriented, discrete-event simulation model of nuclear analytical chemistry operations developed at Los Alamos National Laboratory. Analytical chemistry supports nuclear materials and waste characterization, quality control, and process control. Some major requesting organizations for analytical services are metal preparation, manufacturing, recovery, and waste management. The model tracks the progress of samples from delivery to analytical chemistry through sample management, sample preparation, measurement, data reduction, data management, to delivery of results back to the requester. Analytical chemistry is a key component of material verification and control efforts, and is therefore important to the materials accountability community.
NTIS
Analytical Chemistry; Simulation; Mathematical Models; Nuclear Chemistry

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NUCLEAR PHYSICS

Includes nuclear particles; and reactor theory. For space radiation see 93 Space Radiation. For atomic and molecular physics see 72 Atomic and Molecular Physics. For elementary particle physics see 77 Physics of Elementary Particles and Fields. For nuclear astrophysics see 90 Astrophysics.

20010058871 Fermi National Accelerator Lab., Batavia, IL USA
Magnetic Measurement Results of Tevatron Electron Lens
Jan. 2001; 8p; In English
Report No.(s): PB2001-105610; FERMILAB-CONF-00/338; No Copyright; Avail: National Technical Information Service (NTIS)

The magnetic system of the Tevatron Electron Lens has strict requirements for longitudinal field quality in its superconducting solenoid. In Particular, the deviation of the field lines from a straight line must be less than 0.2 mm along the 1.5-meter central portion of the magnet. These specifications force the magnetic field to be measured with an accuracy of 0.0001. Two field-measuring systems have been constructed and used successfully. The first uses a 3D Hall probe, which simultaneously records the field in every direction for each position. The second method is developed to track field lines and is based on the alignment of a magnetic rod along the field and detection of its angle from the axis. This article presents a short description of the measuring equipment and the main results of each measurement.
NTIS
Particle Accelerators; Magnetic Measurement; Lenses; Superconducting Magnets

20010059182 Fermi National Accelerator Lab., Batavia, IL USA
Stability Issues of the VLHC Rings
Ng, K. Y.; Mar. 2001; 26p; In English; Original contains color illustrations
Report No.(s): PB2001-106024; FERMILAB/TM-2147; No Copyright; Avail: National Technical Information Service (NTIS)

Beam stability issues of the VLHC rings in Phase 1 and Phase 2 are reviewed. For accelerator rings of circumference 232 km and beam pipe radius of the order of 1 cm, the impedance of the vacuum chamber is dominated by the resistive wall. The most dangerous instabilities are the single-bunch transverse mode coupling instability and the transverse coupled bunch instability driven by the resistive wall at sub-revolution frequency. Scaling is studied concerning the thresholds of these instabilities and the dominance of the resistive wall impedance as the size of the accelerator increases.
NTIS
Stability; Storage Rings (Particle Accelerators); Hadrons

20010059594 California Univ., Lawrence Berkeley Lab., Berkeley, CA USA
Analysis of Longitudinal Bunching in an FEL Driven Two-Beam Accelerator
Lidia, S.; Gardelle, J.; Lefevre, T.; Donohue, J. T.; Gouard, P.; 2001; 8p; In English; Original contains color illustrations
Report No.(s): PB2001-105593; No Copyright; Avail: National Technical Information Service (NTIS)

Recent experiments have explored the use of a free-electron laser (FEL) as a buncher for a microwave two-beam accelerator, and the subsequent driving of a standing-wave rf output cavity. Here we present a deeper analysis of the longitudinal dynamics

of the electron bunches as they are transported from the end of the FEL and through the output cavity. In particular, we examine the effect of the transport region and cavity aperture to filter the bunched portion of the beam.
NTIS
Electron Bunching; Accelerators; Free Electron Lasers

74
OPTICS

Includes light phenomena and the theory of optical devices. For lasers see 36 Lasers and Masers.

20010054945 NASA Pasadena Office, CA USA
Apparatus for Direct Optical Fiber Through-Lens Illumination of Microscopy or Observational Objects
Kadogawa, Hiroshi, Inventor, Jet Propulsion Lab., California Inst. of Tech., USA; Feb. 27, 2001; 12p; In English
Patent Info.: Filed 1 Sep. 1999; NASA-Case-NPO-19484-1-CU; US-Patent-6,195,203; US-Patent-Appl-SN-393067; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

In one embodiment of the invention, a microscope or other observational apparatus, comprises a hollow tube, a lens mounted to the tube, a light source and at least one flexible optical fiber having an input end and an output end. The input end is positioned to receive light from the light source, and the output end is positioned within the tube so as to directly project light along a straight path to the lens to illuminate an object to be viewed. The path of projected light is uninterrupted and free of light deflecting elements. By passing the light through the lens, the light can be diffused or otherwise defocused to provide more uniform illumination across the surface of the object, increasing the quality of the image of the object seen by the viewer. The direct undeflected and uninterrupted projection of light, without change of direction, eliminates the need for light-deflecting elements, such as beam-splitters, mirrors, prisms, or the like, to direct the projected light towards the object.
Official Gazette of the U.S. Patent and Trademark Office
Microscopy; Diffusion; Illuminating

20010056608 Colorado Univ., Center for the Study of Earth from Space, Boulder, CO USA
Extraction of Dry Leaf Spectral Features from Reflectance Spectra of Green Vegetation
Gao, Bo-Cai, Colorado Univ., USA; Goetz, Alexander F. H., Colorado Univ., USA; Remote Sensing of the Environment; 1994; ISSN 0034-4257; Volume 47, pp. 369-374; In English
Contract(s)/Grant(s): NAS5-30552; Copyright; Avail: Issuing Activity

Reflectance spectra of green vegetation in the 1.4-2.5 micrometer region are dominated by liquid water absorptions. In this article, we describe the analysis of a set of reflectance spectra of green vegetation, dry vegetation, and liquid water measured in a laboratory using a nonlinear least squares spectral matching technique. We conclude that both the liquid water and the dry materials contribute to the reflectance spectra of green vegetation in the 1.0-2.5 micrometer region. Our matching of data acquired with the Airborne Visible/Infrared Imaging Spectrometer (AVIRIS) over two vegetated areas in Oregon Transect with a pure water spectrum also shows a residual absorption feature near 1.72 micrometers.
Author
Vegetation; Water; Reflectance; Spectra; Leaves

20010058925 NASA Goddard Space Flight Center, Greenbelt, MD USA
Asymptotic Solutions for Optical Properties of Large Particles with Strong Absorption
Yang, Ping, NASA Goddard Space Flight Center, USA; Gao, Bo-Cai, Naval Research Lab., USA; Baum, Bryan A., NASA Langley Research Center, USA; Hu, Yong X., NASA Langley Research Center, USA; Wiscombe, Warren J., NASA Goddard Space Flight Center, USA; Mishchenko, Michael I., NASA Goddard Inst. for Space Studies, USA; Winker, Dave M., NASA Langley Research Center, USA; Nasiri, Shaima L., Wisconsin Univ., USA; Applied Optics; Mar. 20, 2001; ISSN 0003-6935; Volume 40, No. 9, pp. 1532-1547; In English
Contract(s)/Grant(s): DE-AI02-00ER-62901; Copyright; Avail: Issuing Activity

The transverse wave condition is not applicable to the refracted electromagnetic wave within the context of geometrical optics when absorption is involved. Either the transverse magnetic (TM) or the transverse electric (TE) wave condition can be assumed for the wave to locally satisfy the electromagnetic boundary condition in a ray-tracing calculation. The assumed wave mode affects both the reflection and the refraction coefficients. As a result, nonunique solutions for these coefficients are inevitable. In this study the appropriate solutions for the Fresnel reflection-refraction coefficients are identified in light-scattering calculations based on the ray-tracing technique. In particular, a 3x2 refraction or transmission matrix is derived to account for the inhomogeneity of the

refracted wave in an absorbing medium. An asymptotic solution that completely includes the effect of medium absorption on Fresnel coefficients is obtained for the scattering properties of a general polyhedral particle. Numerical results are presented for hexagonal plates and columns with both preferred and random orientations.
Author
Refraction; Transverse Waves; Reflectance; Numerical Analysis; Coefficients

20010059186 Los Alamos National Lab., NM USA
Using Blocks of Skewers for Faster Computation of Pixel Purity Index
Theiler, J.; Lavenier, D. D.; Harvey, N. R.; Perkins, S. J.; Szymanski, J. J.; Oct. 26, 2000; 18p; In English; SPIE Conference Session AM 104 Imaging Spectrometry VI, 30 Jul. - 4 Aug. 2000, San Diego, CA, USA; Sponsored by International Society for Optical Engineering, USA
Report No.(s): PB2001-105678; LA-UR-00-3002; No Copyright; Avail: National Technical Information Service (NTIS)
The pixel purity index (PPI) algorithm proposed by Boardman, et al identifies potential endmember pixels in multispectral imagery. The algorithm generates a large number of skewers (unit vectors in random directions), and then computes the dot product of each skewer with each pixel. We report on a variant of the PPI algorithm in which blocks of B skewers are considered at a time. From the computation of B dot products, one can produce a much larger set of derived dot products that are associated with skewers that are linear combinations of the original B skewers. Since the derived dot products involve only scalar operations, instead of full vector dot products, they can be very cheaply computed.
NTIS
Algorithms; Pixels; Purity; Scalars; Imagery; Skewness

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PLASMA PHYSICS

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

20010057607 Fermi National Accelerator Lab., Batavia, IL USA
Probing Toward the Solid State Plasma Accelerator Frontier Using Channeling Radiation Measurements at the Fermilab A0 Photoinjector
Carrigan, R. A.; Freudenberger, J.; Fritzler, S.; Genz, H.; Richter, A.; Mar. 2001; 14p; In English
Contract(s)/Grant(s): DE-AC02-76CH-03000; BMBF-06-DA-9151; DFG-GK-4/10
Report No.(s): PB2001-105435; FERMILAB-CONF-01/029-E; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
Plasmas offer the possibility of high acceleration gradients. An intriguing suggestion is to use the higher plasma densities possible in solids to get extremely high gradients. Although solid state plasmas might produce high gradients they would pose daunting problems. Crystal channeling has been suggested as one mechanism to address these challenges. There is no experimental or theoretical guidance on channeling in intense electron and laser beams. A high density plasma in a crystal lattice could quench the channeling process. An experiment is being carried out at the Fermilab A0 Photo-Injector Test Facility to observe electron channeling radiation at high bunch charges. An electron beam with up to 8 nC per electron bunch has been used to investigate the electron-crystal interaction. No evidence has been found of significant quenching of channeling at charge densities several orders of magnitude larger than in earlier experiments.
NTIS
Plasma Accelerators; Electron Bunching; Electron Radiation; Injectors; Plasma Guns; Electron Scattering

20010057616 Georgia Inst. of Tech., Fusion Research Center, Atlanta, GA USA
Role of Neoclassical Convection in the Confinement Improvement of Plasmas with Impurity Injection in DIII-D
Stacey, W. M.; Apr. 2001; 20p; In English
Report No.(s): PB2001-104834; GTFR-153; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
It was concluded in a previous analysis of the DIII-D experiments that inward convection of particles and/or momentum plays a role in the improvement of energy confinement with increasing neon injection. In a separate analysis, we have calculated for the same set of DIII-D experiments that the inward neoclassical main ion flux increases with increasing neon injection, producing an inward convective momentum flux which is of the right magnitude to account for the observed increase in central toroidal rotation velocity and improvement in momentum confinement with increasing neon injection. This result motivates us to

investigate the effect of convective transport on the increase in energy confinement time with increasing neon concentration that is observed in this series of DIII-D experiments, which is the purpose of this paper.
NTIS
Convection; Plasma Control; Tokamak Devices; Neon

20010058868 Princeton Univ., Plasma Physics Lab., NJ USA
Tutorial on Basic Principles of Microwave Reflectometry Applied to Fluctuation Measurements in Fusion Plasmas
Nazikian, R.; Kramer, G. J.; Valeo, E.; Feb. 2001; 64p; In English
Report No.(s): PB2001-105601; PPPL-3545; No Copyright; Avail: National Technical Information Service (NTIS)

Microwave reflectometry is now routinely used for probing the structure of magnetohydrodynamic and turbulent fluctuations in fusion plasmas. Conditions specific to the core of tokamak plasmas, such as small amplitude of density irregularities and the uniformity of the background plasma, have enabled progress in the quantitative interpretation of reflectometer signals. In particular the extent of applicability of the 1-D geometric optics description of the reflected field is investigated by direct comparison to 1-D full wave analysis. Significant advances in laboratory experiments are discussed which are paving the way towards a thorough understanding of this important measurement technique. Data is presented from the Tokamak Fusion Test Reactor (R. Hawryluk, Plasma Physics and Controlled Fusion 33, 1509 (1991)) identifying the validity of the geometric optics description of the scattered field and demonstrating the feasibility of imaging turbulent fluctuations in fusion scale devices.
NTIS
Microwave Reflectometers; Magnetohydrodynamics; Turbulent Flow; Plasma Physics; Tokamak Devices; Fusion Reactors

20010059350 Sverdrup Technology, Inc., Huntsville, AL USA
High Latitude Plasma Electrodynamics and Spacecraft Charging in Low Earth Orbit
Minow, Joseph I., Sverdrup Technology, Inc., USA; Neergaard, Linda, Sverdrup Technology, Inc., USA; Maurits, Sergei, Alaska Univ., USA; Hwang, Kai, Computer Sciences Corp., USA; Suggs, Robert, NASA Marshall Space Flight Center, USA; Feb. 12, 2000; 1p; In English; 7th Spacecraft Charging Technology Conference, 23-27 Apr. 2001, Noordwijk, Netherlands
Contract(s)/Grant(s): NAS8-00187; No Copyright; Avail: Issuing Activity; Abstract Only

Studies of spacecraft charging events on satellites over an altitude range of 800 km to 1800 km have established that negative potentials of hundreds of volts, or even kilovolts, are possible in low Earth orbit (LEO) if there is: (1) a large flux of energetic electrons (10's of keV); and (2) a depletion in the ambient plasma density (is less than 1 x 10(exp 4)/cu cm). to date, quantitative estimates of the probability of encountering severe spacecraft charging environments for spacecraft in low Earth orbit with inclinations near 51 degrees applicable for the International Space Station (ISS), Mir, and associated vehicles are based solely on the relative probability of the vehicle encountering auroral precipitation. A number of the basic assumptions that have been adopted in previous estimates of the charging probabilities are considered in this paper. It is often assumed that precipitating electron flux measured at altitudes above 800 km can be simply adopted unmodified for the lower altitude ranges. We first examine the variations in the electron energy spectrum due to interactions of the primary auroral electrons with the atmosphere to demonstrate that indeed the spectrum of energetic auroral electrons is not significantly altered for altitudes greater than approximately 300 km. Observations of energetic electron populations at altitudes of is greater than 800 km are therefore directly applicable to the 350 km to 450 km altitudes at which Mir and the ISS operate.
Author
Plasma Dynamics; Spacecraft Charging; Low Earth Orbits; Electron Energy; Plasma Density; Space Plasmas; Flux (Rate)

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SOLID-STATE PHYSICS

Includes condensed matter physics, crystallography, and superconductivity. For related information see also 33 Electronics and Electrical Engineering and 36 Lasers and Masers.

20010055681 Gordon Research Conferences, Inc., Kingston, RI USA
Magnetic Nanostructure*, 1 Feb. 2000-31 Jan. 2001*
Fert, Albert; Jan. 31, 2001; 7p; In English; Conference held 13-18 Feb 2000, Ventura, CA
Contract(s)/Grant(s): N00014-1-0191
Report No.(s): AD-A389042; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

This conference follows the very successful first and second Gordon Research Conferences on Magnetic Nanostructures that were held in Irsee, Germany, September 1995 and in Ventura, California, USA, January 1998. The purpose of this program is to

bring participants up to date on the latest developments since that time, to analyse their significance, and consider profitable methods of approach for making progress. In general, the conference will concentrate on discussions of the fundamental mechanisms underlying the unusual properties of these structures. A review of known information is not the primary goal.
DTIC
Conferences; Nanostructure (Characteristics); Nanostructures (Devices); Magnetization

20010056904 NASA Ames Research Center, Moffett Field, CA USA
Metallic Electrode: Semiconducting Nanotube Junction Model
Yamada, Toshishige, NASA Ames Research Center, USA; [2001]; 1p; In English; American Physical Society March Meeting, 12-16 Mar. 2001, Seattle, WA, USA; Sponsored by American Physical Society, USA
Contract(s)/Grant(s): DTTS59-99-D-00437/A61812D; No Copyright; Avail: Issuing Activity; Abstract Only

A model is proposed for two observed current-voltage (I-V) patterns in an experiment with a scanning tunneling microscope tip and a carbon nanotube [Collins et al., Science 278, 100 ('97)]. We claim that there are two contact modes for a tip (metal) -nanotube semi conductor) junction depending whether the alignment of the metal and semiconductor band structure is (1) variable (vacuum-gap) or (2) fixed (touching) with V. With the tip grounded, the tunneling case in (1) would produce large dI/dV with V is greater than 0, small dI/dV with V is less than 0, and I = 0 near V = 0 for an either n- or p-nanotube. However, the Schottky mechanism in (2) would result in forward current with V is less than 0 for an n-nanotube, while with V is greater than 0 for an p-nanotube. The two observed I-V patterns are thus entirely explained by a tip-nanotube contact of the two types, where the nanotube must be n-type. We apply this picture to the source-drain I-V characteristics in a long nanotube-channel field-effect-transistor (Zhou et al., Appl. Phys. Lett. 76, 1597 ('00)], and show that two independent metal-semiconductor junctions connected in series are responsible for the observed behavior.
Author
Semiconductors (Materials); Nanotubes; Conductors; Electron Microscopes; Electron Tunneling; Electric Potential

20010056927 North Carolina State Univ., Raleigh, NC USA
Phonons on Quantum Epitaxial Structures Based on Wide Band Gap Materials ***Final Report, 1 Mar. 1997-31 Aug. 2000***
Dutta, Mitra, North Carolina State Univ., USA; Dec. 30, 1998; 160p; In English
Contract(s)/Grant(s): DAAH04-93-D-0003
Report No.(s): AD-A388737; ARO-37205.2-EL; No Copyright; Avail: CASI; A02, Microfiche; A08, Hardcopy

Raman scattering studies were performed on III-V Nitride materials including binary crystals, ternary alloys, and superlattices of GaN/AlN and GaN/AlGaN. Our results show that in AlGaN alloys the asymmetric behavior of the E2 lineshape arises from random disorder; the E2 phonon does not follow a one mode behavior and the AlGaN films on SiC are under small tensile stress. In the InGaN too the Al mode shows a one mode behavior while two mode behavior may be possible for E2. Possible mode mixing takes place. Evidence of inhomogeneities and spinodal decomposition is seen in these films. Phonon lifetime measurements are made in the binary crystals and in every case we see evidence of two lifetime regions. in the superlattices we see anomalous low temperature behavior that is consistent with a density of states of spectral distribution that is due to the roughness of the interfaces and which agrees with TEM measurements. Finally preliminary measurements demonstrate strong interface phonons in the GaN/AlN superlattices which give good agreement with theory.
DTIC
Epitaxy; Phonons; Binary Alloys; Quantum Theory

20010057200 NASA Glenn Research Center, Cleveland, OH USA
In Situ Monitoring of Crystal Growth Using Mephisto
Abbaschian, Reza, Florida Univ., USA; Lian, Y., Florida Univ., USA; deGroh, H., III, NASA Glenn Research Center, USA; Timchenko, V., New South Wales Univ., Australia; Chen, P. Y. P., New South Wales Univ., Australia; Leonardi, E., New South Wales Univ., Australia; deVahlDavis, G., New South Wales Univ., Australia; Microgravity Materials Science Conference 2000; March 2001; Volume 1, pp. 1-20; In English; See also 20010057199; CD-ROM contains the entire Conference Proceedings presented in PDF format
Contract(s)/Grant(s): NCC3-476; No Copyright; Avail: CASI; A03, Hardcopy

Experiments were carried out to study the morphological stability of Bi-1atomic% Sn alloys using the MEPHISTO directional solidification apparatus aboard Space Shuttle Columbia (STS-87, launched November 19, 1997). The research program involved collaboration of the University of Florida, Centre National d'Etudes Spatiales (France), NASA/Glenn Research Center, the National Institute of Standards and Technology, and the University of New South Wales (Australia). The experiments made use of the Seebeck technique to measure the interface temperature, the resistance change across the sample for determination

of the interface velocity, and Peltier current pulsing for demarcation of the interface shape. These data were obtained in real-time during various melting/solidification cycles, and the experiments were controlled via telecommands. The Seebeck signal and temperature measurements in the space experiments, as well as morphological behavior of the solid/liquid interface, were found to be significantly different than those obtained from ground-based studies. For the space-based experiments, interface breakdown was observed at growth velocities of 6.7, 27, and 40 micrometers/s, but not at 1.8 and 3.3 micrometers/s. The results further indicate that the morphological stability threshold for some grain orientations is significantly enhanced, resulting in a staggered planar to cellular transition front. This report summarizes some of these findings.
Author
Morphology; Stability; Liquid-Solid Interfaces; Directional Solidification (Crystals); Tin Alloys

20010057201 Florida Univ., Dept. of Materials Science and Engineering, Gainesville, FL USA
Morphological Stability of Faceted Interfaces
Abbaschian, Reza, Florida Univ., USA; Golyshev, V. D., Center of Thermophysical Research, Russia; Gonik, M., Center of Thermophysical Research, Russia; Tsvetivsky, V., Center of Thermophysical Research, Russia; deVahlDavis, G., New South Wales Univ., Australia; Leonardi, E., New South Wales Univ., Australia; Microgravity Materials Science Conference 2000; March 2001; Volume 1, pp. 21; In English; See also 20010057199; CD-ROM contains the entire Conference Proceedings presented in PDF format
Contract(s)/Grant(s): NAG8-1673; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

The major focus of this investigation is to study the fundamentals of layer spreading mechanisms during growth of doped Ge (a facet forming material), and to determine the conditions for morphological instability of vicinal solid-liquid interfaces. The investigation will also lead to the determination of the effect of dopants on the layer growth kinetics, step free energy, and dopant capture by the advancing ledges. The theoretical treatment of growth of faceted interfaces indicates that the kinetics of a step on a growing vicinal interface considerably depends on its angle of inclination, the melt concentration, and characteristics of flow currents in the melt. The morphological stability of the interface also depends on these parameters, as well as on the density and spreading velocity of the steps. However, the treatment of the instability of the interface by the layer growth mechanism is rather difficult because it requires exact knowledge of the thermal and solutal fields, hydrodynamics of the melt, and supercooling at the interface. The results of recent space experiments of the principal investigator involving directional solidification of faceted Bi-Sn alloys have shown that the morphological stability of various crystallographic orientations is significantly affected by the anistropy in interfacial properties of the faceted alloy in general, and the interface kinetics in particular. These findings have also raised many important and fundamental questions, particularly with respect to the behavior of interfacial steps, which need to be addressed via additional groundbased and microgravity experiments. For the present investigation we will use a novel crystal growth technique which provides axial heat flux close to the solid-liquid boundary. The Axial Heat Processing (AHP) technique allows for precise control and determination of the heat and mass transfer close to the crystallization front, and the establishment of a planar interface over the entire cross-section of the growing crystal.
Author
Crystal Growth; Morphology; Stability; Spreading; Germanium; Doped Crystals; Liquid-Solid Interfaces

20010057213 NASA Glenn Research Center, Cleveland, OH USA
Equiaxed Dendritic Solidification Experiment (EDSE)
Beckermann, C., Iowa Univ., USA; Karma, A., Northeastern Univ., USA; Steinbach, I., Aachener Centrum fuer Erstarrung unter Schwerelosigkeit e.V., Germany; deGroh, H. C., III, NASA Glenn Research Center, USA; Microgravity Materials Science Conference 2000; March 2001; Volume 1, pp. 82-85; In English; See also 20010057199; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A01, Hardcopy

The objective of the research is to quantitatively determine and understand the fundamental mechanisms that control the microstructural evolution during equiaxed dendritic solidification. 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 and solid fraction, the tip selection criterion, and the temperature field in the melt for a range of interaction ”strengths” between the crystals. The experiment extends the microgravity measurements of Glicksman and co-workers isothermal dendritic growth experiment (IDGE) for steady growth of a single dendrite to a case where growth transients are introduced due to thermal interactions between neighboring dendrites - a situation closer 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 be used

to develop and test theories of transient dendritic growth and the solidification of multiple interacting equiaxed crystals in a supercooled melt.
Author
Dendritic Crystals; Microstructure; Morphology; Directional Solidification (Crystals)

20010057214 NASA Glenn Research Center, Cleveland, OH USA
Dendritic Alloy Solidification Experiment (DASE)
Beckermann, C., Iowa Univ., USA; Karma, A., Northeastern Univ., USA; Steinbach, I., Aachener Centrum fuer Erstarrung unter Schwerelosigkeit e.V., Germany; deGroh, H. C., III, NASA Glenn Research Center, USA; Microgravity Materials Science Conference 2000; March 2001; Volume 1, pp. 86-90; In English; See also 20010057199; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A02, Hardcopy

A space experiment, and supporting ground-based research, is proposed to study the microstructural evolution in free dendritic growth from a supercooled melt of the transparent model alloy succinonitrile-acetone (SCN-ACE). The research is relevant to equiaxed solidification of metal alloy castings. The microgravity experiment will establish a benchmark for testing of equiaxed dendritic growth theories, scaling laws, and models in the presence of purely diffusive, coupled heat and solute transport, without the complicating influences of melt convection. The specific objectives are to: determine the selection of the dendrite tip operating state, i.e. the growth velocity and tip radius, for free dendritic growth of succinonitrile-acetone alloys; determine the growth morphology and sidebranching behavior for freely grown alloy dendrites; determine the effects of the thermal/solutal interactions in the growth of an assemblage of equiaxed alloy crystals; determine the effects of melt convection on the free growth of alloy dendrites; measure the surface tension anisotropy strength of succinon itrile -acetone alloys establish a theoretical and modeling framework for the experiments. Microgravity experiments on equiaxed dendritic growth of alloy dendrites have not been performed in the past. The proposed experiment builds on the Isothermal Dendritic Growth Experiment (IDGE) of Glicksman and coworkers, which focused on the steady growth of a single crystal from pure supercooled melts (succinonitrile and pivalic acid). It also extends the Equiaxed Dendritic Solidification Experiment (EDSE) of the present investigators, which is concerned with the interactions and transients arising in the growth of an assemblage of equiaxed crystals (succinonitrile). However, these experiments with pure substances are not able to address the issues related to coupled heat and solute transport in growth of alloy dendrites.
Author
Dendritic Crystals; Solidification; Single Crystals; Microstructure; Melts (Crystal Growth)

20010057217 North Carolina State Univ., Dept. of Physics, Raleigh, NC USA
Theoretical Investigations of the Mechanical and Electrical Properties of Carbon Nanotubes
Bernholc, J., North Carolina State Univ., USA; Roland, C., North Carolina State Univ., USA; Microgravity Materials Science Conference 2000; March 2001; Volume 1, pp. 103-108; In English; See also 20010057199; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A02, Hardcopy

Carbon nanotubes are perhaps one of the more interesting of the new materials to emerge from recent scientific research. This excitement and interest derives largely from the unusual mechanical and electrical properties of nanotubes, which should allow for unique applications of interest to NASA. For example, nanotubes are predicted to be superstrong, lightweight fibers with remarkable resilience to strain. Nanotubes may therefore provide the basis for a new class of composites, as well as providing a fundamental structural component at the nanometer length scale. Turning to their electronic properties, nanotubes may be either metallic or semiconducting, and therefore have the potential of forming the basis of a future, all-carbon nanotube-based microelectronics. On our presentation, we will give a brief description of our theoretical investigations of nanotubes, with a focus on their mechanical and electrical properties. The studies were carried out with a series of complementary numerical methods covering different length and time scales, including ab initio and classical molecular dynamics simulations methods. While the outstanding mechanical properties of carbon nanotubes have already been explored theoretically, there has been, until recently very little understanding of the microscopic origins of these mechanical properties. Our studies show that it is the high strength of the sp2 bond, combined with the remarkable flexibility of the hexagonal network that plays a crucial role in these enhanced properties. Detailed classical and quantum simulations of the strain release mechanisms of nanotubes under tension show that the excess strain is released by the formation of a (5-7-7-5) defect via the rotation of a carbon-carbon bond about its center [1]. Such a defect is formed spontaneously under tensions of 5 %, or more and marks the onset of further transformations, either via plastic transformation (separation of dislocation cores) or brittle (crack formation and extension). Because of the anisotropic nature of the graphene sheet comprising the nanotubes, the specific response of the nanotube depends on the helicity of the nanotube - i.e., the way in which the graphene sheet is rolled. We have therefore calculated a map of the different response of the nanotubes towards strain [2], shown in Figure 1. Roughly speaking, ductile behavior is associated with armchair (n,n) nanotube, while brittle

behavior is characteristic of (n,0) zigzag tubes. to the best of our knowledge, this is the first such classification of the material properties of such a material.
Author
Nanotubes; Carbon; Mechanical Properties; Molecular Dynamics; Numerical Analysis; Microelectronics

20010057221 Illinois Univ., Chicago, IL USA
Three-Dimensional Velocity Field Characterization in a Bridgman Apparatus: Technique Development and Analysis
Slepicka, J. S., Illinois Univ., USA; Ge, Y., Illinois Univ., USA; Cha, S. Stephen, Illinois Univ., USA; Microgravity Materials Science Conference 2000; March 2001; Volume 1, pp. 121-126; In English; See also 20010057199; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A02, Hardcopy

The three-dimensional (3-D) motion of melts is an unavoidable intrinsic problem that arises in crystal growth. It may be the most important physical property, which needs to be accurately characterized for optimization of the processing. The velocity fields are induced even in microgravity space experiments owing to residual gravity and g-jitters. The induced convection can affect the solidification phenomena in various detrimental manners, which causes solute concentration redistribution including end-to-end macro- segregation and radial segregation as well as undesirable temperature variations in a melt. Crystal growth poses challenging experimental restrictions in flow diagnostics, inhibiting the application of conventional planar and point probes. At the current state of both ground- and space-based experiments, appropriate optical diagnostic techniques are thus very necessary to identify the convective velocity effects on crystal growth. The experimental velocity characterization is also vital to the validation and improvement of numerical modeling capability. The goal of this investigation was to develop two unique experimental techniques for measuring 3-D velocity fields closer to a practical state appropriate for microgravity experiments and to apply them to real experimental measurements including a Bridgman crystal growth configuration. The Bridgman configuration is one of the most important basic arrangements and its velocity measurement is of great technological importance. Eventually, application of these techniques can be extended to other space-based experiments through technology perfection and hardware miniaturization, not only for crystal growth but also for other allied areas.
Author
Bridgman Method; Velocity Distribution; Crystal Growth; Diagnosis; Three Dimensional Motion

20010057222 Alabama Univ., Center for Microgravity and Materials Research, Huntsville, AL USA
Differential Phase-Shifting Interferometry Studies of the Onset of Morphological Instability of Stepped Interfaces Growing From Solution
Booth, N. A., Alabama Univ., USA; Vekilov, P., Alabama Univ., USA; Chernov, A. A., Universities Space Research Association, USA; Microgravity Materials Science Conference 2000; March 2001; Volume 1, pp. 127-132; In English; See also 20010057199; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A02, Hardcopy

The general objective of this work is to obtain fundamental insight into the onset and development of morphological instability on stepped crystal interfaces. This problem is part of the general studies of the onset of pattern formation and other self-organizational phenomena in a variety of systems. This phenomenon has added importance as it essentially determines the structure and perfection of the grown crystals. Despite extensive observations and discussions of step bunches, neither their origin, nor their development have thus far been experimentally addressed in a quantitative manner.
Author
Crystals; Differential Interferometry; Morphology; Phase Shift

20010057229 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; Microgravity Materials Science Conference 2000; March 2001; Volume 1, pp. 158-163; In English; See also 20010057199; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A02, Hardcopy

This flight definition project has the specific objective of investigating the kinetics of nucleation and crystal growth in high temperature inorganic oxide, glass forming melts in microgravity. It is related to one of our previous NASA projects that was concerned with glass formation for high temperature containerless melts in microgravity. The previous work culminated in two experiments which were conducted aboard the space shuttle in 1983 and 1985 and which consisted of melting (at 1500 C) and cooling levitated 6 to 8 mm diameter spherical samples in a Single Axis Acoustic Levitator (SAAL) furnace. Compared to other types of materials, there have been relatively few experiments, 6 to 8, conducted on inorganic glasses in space. These experiments have been concerned with mass transport (alkali diffusion), containerless melting, critical cooling rate for glass formation, chemical homogeneity, fiber pulling, and crystallization of glass forming melts. One of the most important and consistent findings

in all of these experiments has been that the glasses prepared in microgravity are more resistant to crystallization (better glass former) and more chemically homogeneous than equivalent glasses made on Earth (1 g). The chemical composition of the melt appears relatively unimportant since the same general results have been reported for oxide, fluoride and chalcogenide melts. These results for space-processed glasses have important implications, since glasses with a higher resistance to crystallization or higher chemical homogeneity than those attainable on Earth can significantly advance applications in areas such as fiber optics communications, high power laser glasses, and other photonic devices where glasses are the key functional materials.
Author
Crystal Growth; Nucleation; Kinetics; Melts (Crystal Growth); Glass; Microgravity

20010057231 Minnesota Univ., Dept. of Chemical Engineering and Materials Science, USA
First Principles Calculations of Molten II-IV Compounds and Their Solidification Behavior
Derby, J. J., Minnesota Univ., USA; Chelikowsky, J. R., Minnesota Univ., USA; Microgravity Materials Science Conference 2000; March 2001; Volume 1, pp. 170-171; In English; See also 20010057199; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A01, Hardcopy

The goal of the ground-based research proposed here is to employ first-principles atomistic simulations to obtain a more fundamental understanding of the physical behavior of molten binary and ternary alloys of the group II elements cadmium (Cd), mercury (Hg), and zinc (Zn), and group VI elements tellurium (Te) and selenium (Se). Specifically, we will employ atomistic simulations with fully quantum mechanical forces. This procedure allows a parameter-free description of the liquid state and has been applied to liquid silicon, germanium and gallium arsenide; the resulting descriptions are in good agreement with existing experimental data. Other than our previous studies of liquid CdTe, no comparable simulations have been performed for 1II-VI semiconductors.
Author
Computerized Simulation; Solidification; Melts (Crystal Growth)

20010057232 Minnesota Univ., Dept. of Chemical Engineering and Materials Science, USA
Theoretical Analysis of 3-D, Transient Convection and Segregation in Microgravity Bridgman Crystal Growth
Derby, J. J., Minnesota Univ., USA; Yeckel, A., Minnesota Univ., USA; Microgravity Materials Science Conference 2000; March 2001; Volume 1, pp. 172-173; In English; See also 20010057199; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A01, Hardcopy

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 are developing rigorous process models that account for such three-dimensional, transient phenomena during melt crystal growth under microgravity conditions. There has long been interest in employing the microgravity environment of space to process advanced materials. Growing crystals in space has the alluring potential to reduce convective flow velocities to the point where diffusion-controlled growth is possible, thus promoting the growth of higher quality crystals and enabling the detailed study of segregation phenomena. Early space experiments confirmed that microgravity processing could significantly reduce the level of melt convection. Uniform doping was not achieved, however, indicating that convection was not completely damped in the melt. Recent experiments conducted on the first USA Microgravity Laboratory also indicated that convection was not totally damped. Clearly, reducing the magnitude of the gravitation force alone was not sufficient to achieve diffusion-controlled growth in these experiments. Other effects can also complicate the microgravity environment, especially those associated with time-dependent changes in the direction and magnitude of the gravity vector (g-jitter). These effects induce flow in the melt that is three-dimensional and time-dependent.
Author
Crystal Growth; Bridgman Method; Gravitational Effects; Spaceborne Experiments; Vibration Effects; Convection

20010057233 Minnesota Univ., Dept. of Chemical Engineering and Materials Science, 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; Microgravity Materials Science Conference 2000; March 2001; Volume 1, pp. 174-175; In English; See also 20010057199; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A01, Hardcopy

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.
Author
Cadmium Tellurides; Crystal Growth; Melts (Crystal Growth); Computerized Simulation; Gravitational Effects

20010057237 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; Microgravity Materials Science Conference 2000; March 2001; Volume 1, pp. 194-198; In English; See also 20010057199; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A01, Hardcopy

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 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. This research program draws 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 NASNs 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.
Author
Bridgman Method; Characterization; Crystal Defects; Crystal Growth; Crystals; Microgravity; Crystallography; Crystallization

20010057240 NASA Marshall Space Flight Center, Huntsville, AL USA
Mechanisms for the Crystallization of Zblan
Ethridge, Edwin C., NASA Marshall Space Flight Center, USA; Tucker, Dennis S., NASA Marshall Space Flight Center, USA; Microgravity Materials Science Conference 2000; March 2001; Volume 1, pp. 210-212; In English; See also 20010057199; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A01, Hardcopy

The heavy metal fluoride glasses represent a class of reasonably good glass forming compositions with very unique infrared optical properties that have been of interest to researchers for 20 years. The most extensively studied glass with the most potential for practical applications is ZBLAN which contains the fluorides of zirconium, barium, lanthanum, aluminum, and sodium. It has a broad transmission range (0.3-6 um), low index of refraction (about 1.43), low dispersion, low Raleigh scattering, ultra-low thermal 2 dispersion, and potential ultra-low signal attenuation. Potential applications include fiber amplifiers, fiber optic gyroscopes, delivery systems for laser cutting, drilling and surgery, radiation resistant data links, nonlinear optical systems, and ultra-low-loss repeater-less transcontinental and transoceanic optical fiber. Potential markets for these materials are in the tens of billions of dollars per year. Optical fiber from this system possess excellent transmission characteristics in the IR, but the glass

is somewhat susceptible to nucleation and crystallization. The theoretical intrinsic loss coefficient for ZBLAN at 2 microns is 0.00 1 dB/Km. Extrinsic losses, however, cause significant attenuation. The lowest loss coefficient measured is 0.7 dB/Km. This compares with the loss coefficient for fiber optic grade fused silica glass of 0.2 dB/Km. The extrinsic losses in ZBLAN have been attributed to 1) impurities which might be lowered by containerless processing and 2) to scattering from micro-crystallites that form during glass preform production or during fiber drawing.
Author
Crystallization; Glass; Heavy Metals; Space Processing; Microgravity; Nucleation; Shearing

20010057242 Alabama Univ., Cener for MIcrogravity and Materials Research, Huntsville, AL USA
Investigation of Vibrational Control of Convective Flows of the Bridgman Crystal Growth Technique
Fedoseyev, Alexandre I., Alabama Univ., USA; Microgravity Materials Science Conference 2000; March 2001; Volume 1, pp. 216-220; In English; See also 20010057199; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A01, Hardcopy

The character of natural buoyant convection in rigidly contained inhomogeneous fluids can be drastically altered by vibration of the container. For certain experiments and operating conditions, vibrations are expected to have a significant influence on heat and mass transfer on board the International Space Station (ISS). Furthermore, it appears that g-jitter vibrations will exist on ISS over a wide range of frequencies. In general, vibrational flows are very complex and are governed by many parameters. This complexity makes it almost impossible to correctly predict vibrational effects empirically. Thus, a careful theoretical approach combined with numerical modeling is essential. Available flight experiment data clearly show that, once initiated by ”g-jitter”, the effects of convective flows can persist for long times even when the g-jitter disturbance (and consequent flow) were short-lived. In many terrestrial crystal growth situations, convective transport of heat and constituent components is dominated by buoyancy driven convection. Control of convective transport continues to be an important aspect of crystal growth research. Several groups are actively pursuing control of convection using static and rotating magnetic fields. Magnetic fields cannot be used for flow control in melts and solutions that are poor conductors. Flow suppression through vibration or vibro-convective mixing may offer an attractive alternative in such cases.
Author
Bridgman Method; Convection; Convective Flow; Crystal Growth; Vibration; Crystallography

20010057243 Stanford Univ., Stanford, CA USA
Investigation of the Crystal Growth of Dielectric Materials by the Bridgman Technique Using Vibrational Control
Feigelson, R. S., Stanford Univ., USA; Zharikov, E. V., Academy of Sciences (USSR), USSR; Microgravity Materials Science Conference 2000; March 2001; Volume 1, pp. 222-227; In English; See also 20010057199; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A02, Hardcopy

The principal goal of this ground-based program 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. The 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. This program together with theoretical and numerical investigations of vibrational control 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.
Author
Bridgman Method; Buoyancy; Crystal Growth; Dielectrics; Vibration; Vibration Effects; Convection

20010057253 NASA Marshall Space Flight Center, Huntsville, AL USA
Utilizing Controlled Vibrations in a Microgravity Environment to Understand and Promote Microstructural Homogeneity During Floating-Zone Crystal Growth
Anilkumar, A. V., Vanderbilt Univ., USA; Bhowmick, J., Vanderbilt Univ., USA; Grugel, R. N., NASA Marshall Space Flight Center, USA; Microgravity Materials Science Conference 2000; March 2001; Volume 1, pp. 279-281; In English; See also 20010057199; CD-ROM contains the entire Conference Proceedings presented in PDF format
Contract(s)/Grant(s): NAG8-1230; No Copyright; Avail: CASI; A01, Hardcopy

Our previous experiments with NaNO3 float-zones revealed that steady thermocapillary flow can be balanced/offset by the controlled surface streaming flow induced by end-wall vibration. In the current experiments we are examining the effects of

streaming flow on steadying/stabilizing nonsteady thermocapillary flow in such zones. to this effect we have set up a controlled NaNO3 half-zone experiment, where the processing parameters, like zone dimensions and temperature gradients, can be easily varied to generate nonsteady thermocapillary flows. In the present paper we present preliminary results of our investigations into stabilizing such flows by employing endwall vibration.
Author
Vibration; Microstructure; Crystal Growth; Thermocapillary Migration

20010057257 NASA Marshall Space Flight Center, Huntsville, AL USA
The Effect of Microgravity on the Growth of Silica Nanostructures
Smith, D. D., NASA Marshall Space Flight Center, USA; Sibille, L., Universities Space Research Association, USA; Cronise, R., NASA Marshall Space Flight Center, USA; Oldenburg, S. J., Rice Univ., USA; Wolfe, D., Rice Univ., USA; Halas, N. J., Rice Univ., USA; Microgravity Materials Science Conference 2000; March 2001; Volume 2, pp. 288-292; In English; See also 20010057256; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A01, Hardcopy

The process of the formation of structures from coagulating ensembles is fundamentally important since the collective behavior of the constituents often results in dramatically improved or unusual mechanical, thermal, chemical, and optical properties. In this study we examine the effect of microgravity on the formation of silica structures, specifically particles and gels. Derived from text
Microgravity; Nanostructure (Characteristics); Silicon Dioxide

20010057260 Vanderbilt Univ., Materials Science and Engineering, USA
Formation of Y(x)Nd(1-x) Ba2Cu3O(7-delta) (0 = or is less than x is less than or = 0.7) Superconductors from an Undercooled Melt Via Aero-Acoustic Levitation
Gustafson, D. E., Vanderbilt Univ., USA; Hofmeister, W. H., Vanderbilt Univ., USA; Bayuzick, R. J., Vanderbilt Univ., USA; Microgravity Materials Science Conference 2000; March 2001; Volume 2, pp. 301-307; In English; See also 20010057256; CD-ROM contains the entire Conference Proceedings presented in PDF format
Contract(s)/Grant(s): NAG8-1275; No Copyright; Avail: CASI; A02, Hardcopy

Melt processing of RE123 superconductors has gained importance in recent years. While the first high temperature superconductors (HTSCs) were made using traditional ceramic press and sinter technology, recent fabrication efforts have employed alternate processing techniques including laser ablation and ion beam assisted deposition for thin film fabrication of tapes and wires and melt growth for bulk materials. to optimize these techniques and identify other potential processing strategies, phase relation studies on HTSCs have been conducted on a wide variety of superconducting compounds using numerous processing strategies. This data has enhanced the understanding of these complex systems and allowed more accurate modeling of phase interactions. All of this research has proved useful in identifying processing capabilities for HTSCs but has failed to achieve a breakthrough for wide spread application of these materials. This study examines the role of full to partial substitution of Nd in the Y123 structure under rapid solidification conditions. Aero-acoustic levitation (AAL) was used to levitate and undercool RE123 in pure oxygen binary alloys with RE = Nd an Y along a range of compositions corresponding to Y(x)Nd(1-x) Ba2Cu3O(7-delta) (0 = or is less than x is less than or = 0.7) which were melted by a CO2 laser. Higher Y content spheres could not be melted in the AAL and were excluded from this report. Solidification structures were examined using scanning electron microscopy, electron dispersive spectroscopy, and powder x-ray diffraction to characterize microstructures and identify phases.
Author
Aeroacoustics; Levitation; Microstructure; High Temperature Superconductors; Melts (Crystal Growth)

20010057261 Kansas State Univ., Manhattan, KS USA
Tailor-Made Impurity Control of Elastic Versus Plastic Domain Switching in Ferroelastic Inclusion Compounds
Hollingsworth, M. D., Kansas State Univ., USA; Peterson, M. L., Kansas State Univ., USA; Brown, M. E., Kansas State Univ., USA; Dudley, M., State Univ. of New York, USA; Raghothamachar, B., State Univ. of New York, USA; Dhanaraj, G., State Univ. of New York, USA; Microgravity Materials Science Conference 2000; March 2001; Volume 2, pp. 308-309; In English; See also 20010057256; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

In this work we seek an understanding of the cooperative, elastic phenomenon of domain switching through comparison of physical properties and defect structures of a series of closely related inclusion compounds that undergo domain switching under applied anisotropic stress (ferroelasticity). These inclusion compounds are based upon the same urea channel framework, but they differ according to the orientation, dimensionality, and cooperatively of specific hydrogen bonding networks. by growing crystals

in the presence of tailor-made impurities, one can disrupt specific hydrogen bond networks and observe measurable changes in the kinetics and reversibility of the ferroelastic response. This comparative method therefore serves as a unique method for understanding the specific molecular mechanisms that control domain switching.
Derived from text
Switching; Impurities; Crystal Growth; Inclusions

20010057265 Arizona Univ., Arizona Materials Lab., Tucson, AZ USA
Non-Equilibrium Phase Transformations
Jackson, Kenneth A., Arizona Univ., USA; Microgravity Materials Science Conference 2000; March 2001; Volume 2, pp. 323-324; In English; See also 20010057256; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A01, Hardcopy

The objective of this program is to develop an understanding of segregation during phase transformations which take place far from equilibrium. Thermodynamics provides the basic framework for analyzing phase equilibria, and it is well known that during rapid phase transformations, equilibrium phenomena such as solute trapping, extended solid solubilities, or even the suppression non-equilibrium of the formation of a phase indicated on the phase diagram can occur. When a transformation occurs far from equilibrium, the progress of the phase change is dominated by kinetics, and it can proceed rapidly to a non-equilibrium state which has a lower free energy than the initial state but a higher free energy than the lowest free energy equilibrium state. Our objective is to develop an understanding of these processes based on experimental studies and the insights provided by computer simulations, so that the occurrence and progress of these phenomena can be predicted and controlled. Projects supported by NASA using levitation and the microgravity environment are making major contributions to our understanding of nucleation and crystallization in the regime where these non-equilibrium effects are very important. Indeed, the structure and properties of materials produced by transformations that occur under conditions that are far from equilibrium is one of the central topics of materials science, and in many instances rapid phase transformations provide a means of developing materials with novel structures and properties. variety of commercial processes operate in this regime, including processes such as rapid solidification, laser melting, plasma spraying, splat quenching, spray powder formation, condensation processes, glass formation, as well as some conventional solidification and crystal growth processes. The non-equilibrium phenomena and segregation effects which are observed during rapid crystallization are not predicted by the standard quasi-equilibrium thermodynamic model for phase transformations. Our Monte Carlo computer simulations capture the essence of these effects. On the simulations, these non-equilibrium phenomena depend on the undercooling, on the growth rate, and on the diffusion coefficient in the fluid phase. These simulation results provide a new framework for the interpretation of these phenomena, and for predicting when they will occur.
Author
Phase Transformations; Equilibrium; Computerized Simulation; Microgravity

20010057271 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 Glenn Research Center, USA; Microgravity Materials Science Conference 2000; March 2001; Volume 2, pp. 346-352; In English; See also 20010057256; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A02, Hardcopy

Solidification experiments, especially microgravity solidification experiments, are often compromised by the evolution of unwanted voids or bubbles in the melt. Although these voids and/or bubbles are highly undesirable, there is currently no effective means of preventing their formation or of eliminating their adverse effects, particularly during microgravity experiments. Marangoni convection caused by these voids can drastically change the transport processes in the melt. Recent microgravity experiments by Matthiesen (1) Andrews (2) and Fripp (3) are perfect examples of how voids and bubbles can affect the outcome of costly space experiments and significantly increase the level of difficulty in interpreting their results. Formation of bubbles have caused problems in microgravity experiments for a long time. Even in the early Skylab mission an unexpectedly large number of bubbles were detected in the four materials processing experiments reported by Papazian and Wilcox (4). They demonstrated that while during ground-based tests bubbles were seen to detach from the interface easily and float to the top of the melt, in low-gravity tests no detachment from the interface occurred and large voids were grown in the crystal. More recently, the lead-tin-telluride crystal growth experiment of Fripp et al.(3) flown aboard the USMP-3 mission has provided very interesting results. The purpose of the study was to investigate the effect of natural convection on the solidification process by growing the samples at different orientations with respect to the gravitational field. Large pores and voids were found in the three solid crystal

samples processed in space. Post-growth characterization of the compositional profiles of the cells indicated considerable levels of mixing even in the sample grown in the hot-on-top stable configuration. The mixing was attributed to thermocapillary convection caused by the voids and bubbles which evolved during growth. Since the thermocapillary convection is orientation-independent, diffusion-controlled growth was not possible in any of the samples, even the top-heated one. These results are consistent with recent studies of thermocapillary convection generated by a bubble on a heated surface undertaken by Kassemi and Rashidnia (5-7) where it is numerically and experimentally shown that the thermocapillary flow generated by a bubble in a model fluid (silicone oil) can drastically modify the temperature field through vigorous mixing of the fluid around it, especially under microgravity conditions.
Author
Marangoni Convection; Solidification; Crystal Growth; Microgravity

20010057273 Kansas State Univ., Dept. of Chemistry, Manhattan, KS USA
Nanocrystal Superlattices: Synthesis and Properties
Lin, X. M., Kansas State Univ., USA; Stoeva, S., Kansas State Univ., USA; Sorenson, C. M., Kansas State Univ., USA; Klabunde, K. J., Kansas State Univ., USA; Microgravity Materials Science Conference 2000; March 2001; Volume 2, pp. 359; In English; See also 20010057256; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

We are developing methods to synthesize large nanocrystal superlattices (NCSL), which are arrays of nanocrystal particles arranged in order analogous to common crystals for which atoms or molecules are building blocks. These superlattices, in general, should exhibit novel properties due to coherent collective interactions of the particles. A key factor in creating these superlattices is control of nanocrystal size distribution, which must be very narrow. In recent work we have developed a digestive ripening process which has proven to narrow the size distribution of gold nanocrystals, which then quickly form NCSL. The size of the NCSL are about 500 nm which are formed from 6 nm gold nanocrystals. The unusual optical, solubility, and specific heat properties have been elucidated, and will be discussed. Work toward growing larger NCSL of gold, and extending to other materials such as silver and cadmium sulfide will also be discussed.
Author
Nanocrystals; Superlattices; Synthesis (Chemistry); Physical Properties

20010057276 Containerless Research, Inc., Evanston, IL USA
Structure-Property Correlation and Phase Transitions in Group IV and III-V Liquids
Krishnan, Shankar, Containerless Research, Inc., USA; Price, David L., Argonne National Lab., USA; Saboungi, Marie-Louise, Argonne National Lab., USA; Microgravity Materials Science Conference 2000; March 2001; Volume 2, pp. 372-373; In English; See also 20010057256; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A01, Hardcopy

Molecular dynamics (MD) simulations and laser pulse-heating studies on amorphous Si have recently been performed which indicate that Si, Ge, and III-V liquids may undergo a first-order liquid-liquid phase transition. For Si and Ge, this transition is predicted in the deeply undercooled liquid. Group III-V liquids are expected to exhibit the transition closer to their respective melting temperatures. The MD simulations predict that the transition occurs from the metallic liquid to a tetrahedrally-coordinated, viscous and semiconducting liquid. However, no direct experimental characterization of the low-coordination phases has been obtained. The purpose of this research is to: (1) search for and independently confirm the existence of such first-order transitions, (2) determine the liquid phase structures across the transition, and (3) measure the electrical conductivities throughout the accessible undercooled liquid ranges for these materials.
Author
Liquid Phases; Molecular Dynamics; Computerized Simulation; Phase Transformations

20010057277 State Univ. of New York, Stony Brook, NY USA
Defects Numerically Decreased
Larson, David J., Jr., State Univ. of New York, USA; Zhang, Hui, State Univ. of New York, USA; Microgravity Materials Science Conference 2000; March 2001; Volume 2, pp. 374; In English; See also 20010057256; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

Many of the most useful detector crystals solidify with a zincblende crystal structure. These zincblende structures are subject to pervasive twinning terrestrially because of low stacking fault energies and low critical resolved shear stress at temperatures near the solidification temperature. These important materials would be enormously benefited by an advance in the understanding

of twin generation, which catastrophically diminishes yield. Further, they would benefit from improved defect minimization strategies during crystal growth and post-solidification processing. The primary objective of this program is to investigate the influences of gravitationally-dependent phenomena (buoyant and hydrostatic) on the growth and quality of zincblende semiconductor crystals. Specifically, we will develop experiments that will use the unique microgravity environment to test the origins of twinning and dislocation generation, multiplication, annihilation, and propagation in Zn-alloyed CdTe (Zn: CdTe). Further, we will test the concept of a soft ampoule wall that will contain the molten liquid and growing crystal but will not plastically deform the solidified crystal, thus eliminating any dislocations resulting from hoop stresses.
Author
Zincblende; Microgravity; Crystal Structure; Crystal Defects

20010057278 NASA Marshall Space Flight Center, Huntsville, AL USA
Growth of Solid Solution Single Crystals
Lehoczky, Sandor L., NASA Marshall Space Flight Center, USA; Szofran, F. R., NASA Marshall Space Flight Center, USA; Gillies, Donald C., NASA Marshall Space Flight Center, USA; Microgravity Materials Science Conference 2000; March 2001; Volume 2, pp. 375-376; In English; See also 20010057256; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A01, Hardcopy

The solidification of a solid solution semiconductor, having a wide separation between liquidus and solidus has been extensively studied in ground based, high magnetic field and Spacelab experiments. Two alloys of mercury cadmium telluride have been studied; with 80.0 mole percent of HgTe and 84.8 mole percent of HgTe respectively, the remainder being cadmium telluride. Such alloys are extremely difficult to grow by directional solidification on earth due to high solutal and thermal density differences that give rise to fluid flow and consequent loss of interface shape and composition. Diffusion controlled growth is therefore impossible to achieve in conventional directional solidification. The ground based experiments consisted of growing crystals in several different configurations of heat pipe furnaces, NASA's Advanced Automated Directional Solidification Furnace (AADSF), and a similar furnace incorporated in a superconducting magnet capable of operating at up to 5T. The first microgravity experiment took place during the flight of STS-62 in March 1994, with the AADSF installed on the second USA Microgravity Payload (USMP-2). The alloy was solidified at 3/4 inch per day over a 9 day period, and for the first time a detailed evaluation was performed correlating composition variations to measured residual acceleration. The second flight experiment took place in the fourth USA Microgravity Payload Mission (USMP-4) in November 1997. Due to contamination of the furnace system, analysis shows that the conditions prevailing during the experiment were quite different from the requirements requested prior to the mission. The results indicate that the sample did accomplish the desired objectives.
Author
Single Crystals; Solid Solutions; Microgravity; Directional Solidification (Crystals); Gravitational Effects; Crystal Growth

20010057283 Missouri Univ., Dept. of Mechanical and Aerospace Engineering and Engineering Mechanics, Rolla, MO USA
Models of Mass Transport During Microgravity Crystal Growth of Alloyed Semiconductors in a Magnetic Field
Ma, Nancy, Missouri Univ., USA; Microgravity Materials Science Conference 2000; March 2001; Volume 2, pp. 401-406; In English; See also 20010057256; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A02, Hardcopy

Alloyed semiconductor crystals, such as germanium-silicon (GeSi) and various II-VI alloyed crystals, are extremely important for optoelectronic devices. Recent rapid advances in optoelectronics have led to a great demand for more and larger crystals with fewer dislocations and other microdefects and with more uniform and controllable compositions. Currently, alloyed crystals grown by bulk methods have unacceptable levels of segregation in the composition of the crystal. The present research is focused on developing asymptotic models which investigate the effects of the transport phenomena during the Bridgman growth of these alloyed semiconductors in a magnetic field on the segregation in the entire crystal. This research supports experiments being conducted at the Marshall Space Flight Center (MSFC) and future experiments on the International Space Station (ISS). Several studies have been conducted which contribute to the understanding of the melt motion and of the dopant segregation during crystal growth by the Bridgman process with a magnetic field both (1) on earth and (2) in microgravity. (1) The effects of various process parameters on the dopant segregation in the entire crystal during the vertical Bridgman process and during an idealized horizontal Bridgman process in the presence of a magnetic field has been investigated. (2) The effect of a steady transverse residual acceleration on the buoyant convection has been investigated, while the effect of a steady axial residual acceleration on the buoyant convection and on the dopant segregation has been investigated. These models of melt motion and dopant transport provide very important basic understanding of mass transport during crystal growth, and a mechanism to develop

ways to treat the transient mass transport during alloyed crystal growth. They also provide a benchmark for the treatment of more complicated problems involving alloyed crystal growth and residual accelerations.
Author
Alloying; Crystal Growth; Magnetic Fields; Microgravity; Semiconductors (Materials); Transport Properties; Mathematical Models; Crystal Defects

20010057284 Honeywell Technology Center, Morristown, NJ USA
Carbon Nanotubes Growth and Container-Less Directional Crystallization (CDC) in Microgravity for Electromechanical Actuation Applications
Zakhidov, A. A., Honeywell Technology Center, USA; Khayrullin, I. I., Honeywell Technology Center, USA; Morris, R., Morris Research, USA; MacKnight, A., Honeywell Technology Center, USA; Baughman, R. H., New Jersey Inst. of Tech., USA; Rakov, V., Institute of Chemical Problems of Microelectronics, Russia; Kartavykh, A., Institute of Chemical Problems of Microelectronics, Russia; Ufimtsev, V., Institute of Chemical Problems of Microelectronics, Russia; Jouravlev, O., Institute of Chemical Problems of Microelectronics, Russia; Microgravity Materials Science Conference 2000; March 2001; Volume 2, pp. 407-408; In English; See also 20010057256; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A01, Hardcopy

We have demonstrated a new type of electromechanical actuator, which is based on both a new type of actuator material (single-wall carbon nanotubes) and a new type of actuation mechanism (double-layer charge injection). Like natural muscles, the macroscopic actuators are assemblies of billions of individual nanoscale actuators. Higher stress generation capabilities than natural muscles and higher strains than high modulus ceramics were obtained in investigations of both all-solid-state and liquid-electrolyte -based devices. Analysis of experimental results suggest that these actuators have the potential of providing order of magnitude advantages over prior-art technologies in work per cycle and stress generation. Also, they operate at very low voltages and high temperatures. However, realization of these expected advantages of carbon nanotube actuators has been frustrated by materials limitations that restrict the mechanical properties of carbon nanotube sheets. Key issues are the development of methods for the synthesis of extra long and impurity-free nanotubes that have low defect concentrations, the separation of these nanotubes into metallic and semiconducting tubes, and the assembly of these nanotubes into strong, high-surface-area structures in which the nanotubes are largely unbundled. First, two tasks can be solved in a microgravity synthesis, when CNT are levitating in a reaction zone and have a chance to grow longer than the conventional synthetic conditions. The program being initiated will focus on improving nanotube synthesis in arc-discharge chamber and processing by mimicking some of the advantages of microgravity processing. The talk will describe the present status of nanotube actuator development, and the strategies being pursued to improve the quality of carbon nanotubes and carbon nanotube sheets.
Author
Carbon; Nanotubes; Crystallization; Microgravity; Electromechanical Devices; Actuators; Crystal Growth; Directional Solidification (Crystals)

20010057290 NASA Marshall Space Flight Center, Huntsville, AL USA
Effects of Traveling Magnetic Field on Dynamics of Solidification
Mazuruk, Konstantin, NASA Marshall Space Flight Center, USA; Grugel, Richard, NASA Marshall Space Flight Center, USA; Motakef, Shariar, NASA Marshall Space Flight Center, USA; Microgravity Materials Science Conference 2000; March 2001; Volume 2, pp. 423-429; In English; See also 20010057256; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A02, Hardcopy

TMF is based on imposing a controlled phase-shift in a train of electromagnets, forming a stack. Thus, the induced magnetic field can be considered to be travelling along the axis of the stack. The coupling of this traveling wave with an electrically conducting fluid results in a basic flow in a form of a single axisymmetric roll. The magnitude and direction of this flow can be remotely controlled. Furthermore, it is possible to localize the effect of this force field though activating only a number of the magnets. This force field generated in the fluid can, in principle, be used to control and modify convection in the molten material. For example, it can be used to enhance convective mixing in the melt, and thereby modify the interface shape, and macrosegregation. Alternatively, it can be used to counteract thermal and/or solutal buoyancy forces. High frequency TMF can be used in containerless processing techniques, such as float zoning, to affect the very edge of the fluid so that Marangoni flow can be counter balanced. The proposed program consists of basic fundamentals and applications. Our goal in conducting the following experiments and analyses is to establish the validity of TMF as a new tool for solidification processes. Due to its low power consumption and simplicity of design, this tool may find wide spread use in a variety of space experiments. The proposed ground based experiments are intended to establish the advantages and limitations of employing this technique. In the fundamentals component of the proposed program, we will use theoretical tools and experiments with mercury to establish the

fundamental aspects of TMF-induced convection through a detailed comparison of theoretical predictions and experimental measurements of flow field. In this work, we will conduct a detailed parametric study involving the effects of magnetic field strength, frequency, wave vector, and the fluid geometry. The applications component of this work will be focused on investigating the effect of TMF on the following solidification and pre-directional solidification processes: (1) Bridgman growth of Ga:Ge with the goal of counteracting the buoyancy-driven convection; (2) Mixing of Pb-Ga and Pb-Sn alloys with the aim of initiating and maintaining a uniform melt prior to solidification processing; and (3) Float Zone growth with the aim of identifying, through simulations and model experiments, conditions needed to counteract Marangoni flow in a microgravity environment. The proposed research has strong relevance to microgravity research and the objectives of the NRA. TMF can provide a unique and accurate mechanism for generation and control of desirable flow patterns for microgravity research. These attributes have significant relevance to 1) Alloy mixing prior to solidification in a microgravity environment. TMF can provide this mixing with a low level of power consumption; (2) TMF can offset the deleterious effects of Marangoni convection in microgravity containerless processing. Thus, TMF can be instrumental in further understanding this phenomena; (3) Generation of controlled flows will allow the investigation of the effect of these flows on growth morphology and growth kinetics; and (4) On Earth, TMF has the potential to significantly counter-balance thermosolutal convection, thereby creating conditions similar to those obtained in microgravity. Once demonstrated, this new tool for use in solidification has the strong potential to find applications in a host of microgravity material research projects.
Author
Directional Solidification (Crystals); Magnetic Fields; Microgravity; Crystal Growth; Magnetic Effects; Space Processing; Melts (Crystal Growth); Bridgman Method

20010057291 National Inst. of Standards and Technology, Gaithersburg, MD USA
Convective and Morphological Instabilities During Crystal Growth
Coriell, S. R., National Inst. of Standards and Technology, USA; McFadden, G. B., National Inst. of Standards and Technology, USA; Murray, B. T., State Univ. of New York, USA; Microgravity Materials Science Conference 2000; March 2001; Volume 2, pp. 430-434; In English; See also 20010057256; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A01, Hardcopy

During crystal growth or solidification of a binary alloy from a liquid phase, temperature and solute gradients are inherently present. In a gravitational field, these gradients can give rise to fluid flow in the melt. The interaction of fluid flow with the crystal-melt interface plays an important role in determining the properties of the solidified material. Convection in the melt and interface instability may both produce solute inhomogeneities. In the absence of fluid flow, the conditions for the onset of morphological instability of isotropic materials are well established. However, the coupling between morphological instability and fluid flow can be complicated; interfacial instabilities depend on temperature and solute gradients that may be strongly influenced by the flow field. The flow field, in turn, may be influenced by the morphology of the interface. There have been extensive measurements directed toward an understanding of dendritic growth from pure supercooled melts. Of primary interest has been a comparison with theory of the dependence of the growth speed, V, and the tip radius, R, on the supercooling. One ingredient of the theoretical basis for this comparison is the Ivantsov solution, which is an exact solution for the steady-state growth of an isothermal semi-infinite paraboloid of revolution. This solution results in a relationship between the of Stefan number, S, (dimensionless supercooling) and the Peclet number, Pe, (dimensionless product of tip radius R and tip velocity V). For this solution the solid is isothermal and is assumed to have the same density as the liquid. The supercooling is the difference between the melting point of the material and the bath temperature. The second theoretical ingredient has been a value of the selection parameter, which is a dimensionless product of the tip velocity and the square of the tip radius; values of the selection parameter have been calculated from considerations of marginal stability and from the theory of microscopic solvability. Recently, Glicksman et al. have performed very careful measurements of the dendritic growth of pure succinonitrile (SCN) in microgravity in order to reduce fluid convection and thus to conduct astringent test of the above relationships. For measurements down to supercoolings of 0.05 K, reasonable agreement is obtained. Independent of selection, there appears to be a systematic discrepancy from the Ivantsov relationship. For supercoolings between 0.5 K and I K, the measured supercooling for a given Peclet number is about 10% higher than would be predicted by the Ivantsov relationship (see Figure 10 of Reference Some possible reasons for this discrepancy are the effect of finite container size, thermal fields due to other dendrites, and deviations of shape from a paraboloid of revolution. In previous work we have performed a number of investigations concerning the effect of fluid flow on dendritic growth. A closed form solution giving the effect of flow normal to the crystal-melt interface due to a density change upon solidification has been obtained. This work extended the conduction solution of Ivantsov to the case of convective transport of

the thermal field. These results have recently been utilized by Chait et al. to further analyze the dendritic growth experiments of Glicksman et al.
Author
Crystal Growth; Dendritic Crystals; Melts (Crystal Growth); Gravitational Fields; Morphology; Solidification; Convection; Binary Alloys; Microgravity

20010057297 NASA Marshall Space Flight Center, Huntsville, AL USA
Space- and Ground-Based Crystal Growth Using a Baffle (CGB)
Ostrogorsky, A. G., Alabama Univ., USA; Marin, C., Alabama Univ., USA; Peignier, T., Alabama Univ., USA; Duffar, T., Commissariat a l'Energie Atomique, France; Volz, M., NASA Marshall Space Flight Center, USA; Jeter, L., NASA Marshall Space Flight Center, USA; Luz, P., NASA Marshall Space Flight Center, USA; Microgravity Materials Science Conference 2000; March 2001; Volume 2, pp. 451-457; In English; See also 20010057256; CD-ROM contains the entire Conference Proceedings presented in PDF format
Contract(s)/Grant(s): NRA-94-OLMSA-06; No Copyright; Avail: CASI; A02, Hardcopy

The composition of semiconductor crystals produced in space by conventional melt-growth processes (directional solidification and zone melting) 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 apriori unpredictable. As a result, the composition of the crystals grown in space can not be predicted and reproduced. The method for directional solidification with a submerged heater or a baffle was developed under NASA sponsorship. The disk-shaped baffle acts as a partition, creating a small melt zone at the solid-liquid interface. As a result, in ground based experiment the level of buoyancy-driven convection at the interface is significantly reduced. In several experiments with Te-doped GaSb, nearly diffusion controlled segregation was achieved.
Author
Directional Solidification (Crystals); Crystal Growth; Baffles; Bridgman Method; Semiconductors (Materials); Melts (Crystal Growth); Convection; Doped Crystals; Microgravity

20010057304 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; Wang, Yazhen, Clarkson Univ., USA; Burkhard, Craig, Clarkson Univ., USA; Microgravity Materials Science Conference 2000; March 2001; Volume 3, pp. 487-492; In English; See also 20010057302; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A02, Hardcopy

"Detached solidification" is the term we use to describe the situation where the growing solid is not in intimate contact with the ampoule wall. Detachment has very often been observed in microgravity experiments, including full detachment in which the growth interface nowhere contacts the ampoule wall. The flight experiments have been explained by the Moving Meniscus Model, in which a liquid meniscus is between the periphery of the growth interface and the ampoule wall. As freezing proceeds down the ampoule, the liquid meniscus is forced to move along the wall. The melt itself remains in contact with the ampoule wall while there is a gap between the solid and the wall. This gap is filled with a gas which was dissolved in the melt and segregated out by the growing solid. This is equivalent to a gas bubble surrounding (or partially surrounding) the periphery of the growth interface. The objectives of the current grant are to: Further develop our theoretical model in order to provide understanding and guidance for achievement of detached solidification in microgravity experiments; Develop a low-melting, transparent system that can be used to observe detached solidification as it occurs, along with convection in the melt; Observe bubble formation and interaction with the freezing interface; and Attempt to achieve detached solidification on earth.
Author
Crystals; Solidification; Detachment; Microgravity; Semiconductors (Materials); Menisci; Crystal Growth; Walls; Ampoules; Solid-Solid Interfaces

20010057307 Carnegie-Mellon Univ., Dept. of Materials Science and Engineering, Pittsburgh, PA USA
Shape Change Kinetics of Faceted Crystals
Mullins, William W., Carnegie-Mellon Univ., USA; Rohrer, Gregory S., Carnegie-Mellon Univ., USA; Microgravity Materials Science Conference 2000; March 2001; Volume 3, pp. 505-509; In English; See also 20010057302; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A01, Hardcopy

When small ceramic particles facet, they reduce the driving force for sintering without necessarily increasing the density of the product. Predictive, quantitative models to relate the processing, structure, and properties of sintered bodies must include an

accurate description of this phenomenon. The objective of this project, which is scheduled to begin in the near future, is to determine the minimum energy shapes for small crystallites and to determine the mechanism by which they reach this shape.
Author
Ceramics; Crystallites; Flat Surfaces; Kinetics; Nucleation; Shapes; Sintering; Microgravity; Mobility; Crystal Structure; Microcrystals; Crystal Lattices

20010057310 Worcester Polytechnic Inst., Mechanical Engineering Dept., MA USA
Particle-Fluid Dynamics Under Variable Gravity Conditions
Alexandrou, Andreas N., Worcester Polytechnic Inst., USA; Lemidiasov, R. A., Worcester Polytechnic Inst., USA; Gatsonis, N. A., Worcester Polytechnic Inst., USA; Sacco, Albert, Jr., Northeastern Univ., USA; Microgravity Materials Science Conference 2000; March 2001; Volume 3, pp. 517-518; In English; See also 20010057302; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A01, Hardcopy

Crystals grown from specially prepared liquid solutions have important industrial applications. The efficiency of these crystals is usually a function of their size. Therefore, during the synthesis of the crystals, it is important to optimize their size, and to control the defect location and concentration. For this reason, crystals have been grown in space in order to take advantage of the reduced gravity. In this paper we discuss the description of macroscopic fluid-crystal dynamics under various microgravity conditions in a 3-D cubic container. The process is modeled using the conservation of mass and momentum equations for the fluid phase and a discrete particle model for the crystals. The settling particles exert a force on the ambient fluid and, therefore, they induce bulk motion. The force on the fluid is applied at the point where the particles reside. Fluid was considered to be Newtonian and no-slip boundary conditions for the fluid were applied on the sides of the cubic container.
Author
Conservation Laws; Microgravity; Mathematical Models; Crystals; Crystal Growth; Size Distribution; Solutions; Fluid Flow; Particle Motion; Momentum Theory

20010057316 NASA Glenn Research Center, Cleveland, OH USA
Flight Experiment to Study Double-Diffusive Instabilities in Silver-Dopped Lead Bromide Crystals
Singh, N. B., Northrop Grumman Corp., USA; Adam, J. D., Northrop Grumman Corp., USA; Zhang, Hui, Northrop Grumman Corp., USA; Coriell, Sam. R., National Inst. of Standards and Technology, USA; Duval, Walter M. B., NASA Glenn Research Center, USA; Microgravity Materials Science Conference 2000; March 2001; Volume 3, pp. 548-550; In English; See also 20010057302; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A02, Hardcopy

The main objective of the present program is to understand thermosolutal convection during crystal growth of PbBr2-AgBr alloys. This involves identification of the growth conditions for microgravity experiments delineating the microsegregation, observation of convecto-diffusive instabilities and comparison with theoretical models. The overall objectives can be summarized as follows: 1. Observe and study the double diffusive and morphological instabilities in controlled conditions and to compare with theoretically predicted convective and morphological instability curves. 2. Study the three-dimensional morphological instabilities and resulting cellular growth that occur near the onset of morphological instability in the bulk samples under purely diffusive conditions. 3. Understand the micro-and macro-segregation of silver dopant in lead bromide crystals in microgravity. 4. Provide basic data on convective behavior in alloy crystals grown by the commercially important Bridgman crystal growth process.
Author
Silver Bromides; Lead (Metal); Crystal Growth; Gravitational Effects; Diffusivity; Spaceborne Experiments; Bridgman Method; Stability

20010057318 NASA Marshall Space Flight Center, Huntsville, AL USA
Particle Engulfment and Pushing by Solidifying Interfaces
Stefanescu, Doru M., Alabama Univ., USA; Mukherjee, Sundeep, Alabama Univ., USA; Juretzko, Frank Robert, Alabama Univ., USA; Catalina, A.drian V., Universities Space Research Association, USA; Sen, Subhayu, Universities Space Research Association, USA; Curreri, P. A., NASA Marshall Space Flight Center, USA; Microgravity Materials Science Conference 2000; March 2001; Volume 3, pp. 556-561; In English; See also 20010057302; CD-ROM contains the entire Conference Proceedings presented in PDF format
Contract(s)/Grant(s): NAS8-39715; No Copyright; Avail: CASI; A02, Hardcopy

The phenomenon of interaction of particles with solid-liquid interfaces (SLI) has been studied since the mid 1960's. While the original interest stemmed from geology applications (frost heaving in soil), researchers soon realized that fundamental

understanding of particles behavior at solidifying interfaces might yield practical benefits in other fields, including metallurgy. In materials engineering the main issue is the location of particles with respect to grain boundaries at the end of solidification. Considerable experimental and theoretical research was lately focused on applications to metal matrix composites produced by casting or spray forming techniques, and on inclusion management in steel. Another application of particle SLI interaction is in the growing of Y1Ba2Cu3O(7-delta) (123) superconductor crystals from an undercooled liquid. The oxide melt contains Y2Ba1Cu1O5 (211) precipitates, which act as flux pinning sites. The experimental evidence on transparent organic materials, as well as the recent in situ observations on steel demonstrates that there exist a critical velocity of the planar SLI below which particles are pushed ahead of the interface, and above which particles are engulfment. The engulfment of a SiC particle in succinonitrile is exemplified. However, in most commercial alloys dendritic interfaces must be considered. Indeed, most data available on metallic alloys are on dendritic structures. The term engulfment is used to describe incorporation of a particle by a planar or cellular interface as a result of local interface perturbation, as opposed to entrapment that implies particle incorporation at cells or dendrites boundaries. During entrapment the particles are pushed in the intercellular or interdendritic regions and then captured when local solidification occurs. The physics of these two phenomena is fundamentally different.
Author
Solidification; Particle Interactions; Liquid-Solid Interfaces; Superconductors (Materials); Metal Matrix Composites

20010057319 NASA Marshall Space Flight Center, Huntsville, AL USA
Structural Fluctuations and Thermophysical Properties of Molten II-VI Compounds
Su, Ching-Hua, NASA Marshall Space Flight Center, USA; Feth, Shari, Alabama Univ., USA; Lehoczky, Sandor, NASA Marshall Space Flight Center, USA; Mook, Herb A., Oak Ridge National Lab., USA; Scripa, Rose, Alabama Univ., USA; Zhu, Shen, Universities Space Research Association, USA; Microgravity Materials Science Conference 2000; March 2001; Volume 3, pp. 562-567; In English; See also 20010057302; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A02, Hardcopy

Recently, in support of the microgravity experiment entitled ”Crystal Growth of Selected 11-VI Semiconducting Alloys by Directional Solidification,” the viscosity of HgZnTe pseudobinary melt was measured using an oscillating-cup viscometer at NASA/Marshall Space Flight Center (MSFC). An unexpected time drift of the measured viscosity, which shows a slow relaxation phenomena at temperatures near the liquidus point, was reproducibly observed. Two sets of data were obtained by cooling the Hg(0.84)Zn(0.16)Te melt from 850 C and stabilizing at temperatures of 790 C, which is just above the liquidus temperature, and stabilizing at temperature of 810 C. While it took one day to reach equilibration at 810 C, five days were required at 790 C A similar relaxation phenomenon was also observed in the measured density of the same liquid. Furthermore, in the density measurements of the HgCdTe melts, which is the pseudobinary system studied in another flight experiment entitled ”Growth of Solid Solution Single Crystals,” a negative thermal expansion was reported. The liquid density increases from the liquidus point to a maximum value at a temperature approximately 700 C above the liquidus, where normal thermal expansion progressively resumes.
Author
Thermophysical Properties; Structural Analysis; Crystal Growth; Semiconductors (Materials); Mercury Cadmium Tellurides

20010057320 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, Robert F., Marquette Univ., USA; Volz, Martin P., NASA Marshall Space Flight Center, USA; Burger, Arnold, Fisk Univ., USA; Dudley, Michael, State Univ. of New York, USA; Matyi, Richard J., Wisconsin Univ., USA; Ramachandran, Narayanan, Universities Space Research Association, USA; Sha, Yi-Gao, Universities Space Research Association, USA; Volz, Martin P., NASA Marshall Space Flight Center, USA; Shih, Hung-Dah, Central Research Labs., USA; Microgravity Materials Science Conference 2000; March 2001; Volume 3, pp. 568-572; In English; See also 20010057302; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A01, Hardcopy

Crystal growth by vapor transport has several distinct advantages over melt growth techniques. Among various potential benefits from material processing in reduced gravity the followings two are considered to be related to crystal growth by vapor transport: (1) elimination of the crystal weight and its influence on the defect formation and (2) reduction of natural buoyancy-driven convective flows arising from thermally and/ or solutally induced density gradient in fluids. The previous results on vapor crystal growth of semiconductors showed the improvements in surface morphology, crystalline quality, electrical properties and dopant distribution of the crystals grown in reduced gravity as compared to the crystals grown on Earth. But the

mechanisms, which are responsible for the improvements and cause the gravitational effects on the complicated and coupled processes of vapor mass transport and growth kinetics, are not well understood.
Author
Crystal Growth; Zinc; Selenium; Vapor Deposition; Gravitational Effects

20010057321 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; Cobb, Sharon D., NASA Marshall Space Flight Center, USA; Croell, Arne, Alabama Univ., USA; Dold, Peter, Freiburg Univ., Germany; Kaiser, Natalie, Freiburg Univ., Germany; Motakef, Shariar, Cape Simulations, Inc., USA; Schweizer, Marcus, Freiburg Univ., Germany; Volz, Martin P., NASA Marshall Space Flight Center, USA; Vujisic, Ljubomir, Cape Simulations, Inc., USA; Microgravity Materials Science Conference 2000; March 2001; Volume 3, pp. 573-579; In English; See also 20010057302; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A02, Hardcopy

Crystals grown without being in contact with a container have superior quality to otherwise similar crystals grown in direct contact with a container, especially with respect to impurity incorporation, formation of dislocations, and residual stress in the crystals. In addition to float-zone processing, detached Bridgman growth, although not a completely crucible-free method, is a promising tool to improve crystal quality. It does not suffer from the size limitations of float zoning and the impact of thermocapillary convection on heat and mass transport is expected to be negligible. Detached growth has been observed frequently during (micro)g experiments. Considerable improvements in crystalline quality have been reported for these cases. However, neither a thorough understanding of the process nor a quantitative assessment of the quality of these improvements exists. This project will determine the means to reproducibly grow Pepsi alloys in a detached mode and seeks to compare processing-induced defects in Bridgman, detached-Bridgman, and floating-zone growth configurations in Pepsi crystals (Si less or = 10 at%) up to 20mm in diameter.
Author
Crystal Growth; Defects; Germanium; Residual Stress; Silicon

20010057326 Massachusetts Univ., Dept. of Chemical Engineering, Amherst, MA USA
Growth Studies of Silicalite-1 Crystals and Thin Films
Tsapatsis, Michael, Massachusetts Univ., USA; Vlachos, Dionisios G., Massachusetts Univ., USA; Nikolakis, V., Massachusetts Univ., USA; Bonilla, G., Massachusetts Univ., USA; Microgravity Materials Science Conference 2000; March 2001; Volume 3, pp. 608-613; In English; See also 20010057302; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A02, Hardcopy

Zeolites and molecular sieve materials, in general, are ordered framework structures with highly regular, ordered cages and channels of nanometer scale. Their tailored structure, stability and activity led to the development of numerous, traditional applications in hydrocarbon conversion, size/shape selective catalysis and separation processes. Molecular sieve thin films are highly desirable for the preparation of novel chemical reactors, selective chemical sensors and membranes. However, the preparation of zeolite films and membranes for demanding applications, like membrane reactors and hydrocarbon or permanent gases separations, is hindered by the lack of suitable membrane formation processes leading to films with controlled microstructures, and by the limited fundamental understanding linking microstructure with separation properties. Our research objective focuses on addressing the critical issues of microstructure control and predictive mathematical modeling linking processing and microstructure with separation performance. We are developing simulations with the ultimate goal of developing predictive models based on fundamentals of crystal growth, colloidal interactions, and transport phenomena. Along with these fundamental studies, we are exploring potential applications of zeolite films for separation of close boiling hydrocarbons.
Author
Crystal Growth; Thin Films; Zeolites; Sieves; Prediction Analysis Techniques; Microstructure; Silicon Dioxide

20010057328 Illinois Univ., Dept. of Mechanical and Industrial Engineering, Urbana, IL USA
Modelling the Effects of Magnetic Fields in Crystal Growth
Walker, John S., Illinois Univ., USA; Microgravity Materials Science Conference 2000; March 2001; Volume 3, pp. 619-623; In English; See also 20010057302; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A01, Hardcopy

During the last two years, we have developed a number of models to help optimize the benefits of applying steady or periodic magnetic fields during the bulk growth of semiconductor crystals on Earth or in microgravity.
Author
Magnetic Fields; Rotation; Crystal Growth; Semiconductors (Materials); Microgravity; Models

20010057334 Massachusetts Inst. of Tech., Cambridge, MA USA
Identification and Control of Gravity Related Defect Formation During Melt Growth of Electro-Optic Single Crystals: Sillenties, Bismuth Silicate (Bi(12),SiO(20))
Wiegel, Michaela E. K., Massachusetts Inst. of Tech., USA; Witt, August F., Massachusetts Inst. of Tech., USA; Microgravity Materials Science Conference 2000; March 2001; Volume 3, pp. 656-657; In English; See also 20010057302; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A01, Hardcopy

A research program is being conducted which is expected to lead to the identification and control of gravitational effects which adversely impact, through their interference with the growth process, critical application specific properties in the photorefractive sillenite system Bi(12)SiO(20). The research places focus on a class of materials with acousto-optic, piezoelectric, and outstanding electro-optic properties, which suggest a broad spectrum of device applications. Realization of the full potential of these materials remains impeded, primarily because of our current inability, in ground-based experiments, to control during growth adequately composition (on a micro scale), critical crystal defect formation as well as confinement related contamination and appearance of lattice stress. Selective reduction of the primary driving force for convective melt flows, achieved in microgravity growth experiments, is expected to greatly facilitate the establishment of cause and effect relationship for defect formation, advance our understanding of the crystal growth process and thus provide for enhanced property control during crystal growth and establish a basis for the development of effective defect engineering directed at the optimization of application-specific properties in BSO and in electro-optical materials in general.
Author
Gravitational Effects; Crystal Defects; Crystal Growth; Melts (Crystal Growth); Electro-Optics; Bismuth; Silicates

20010058680 NASA Glenn Research Center, Cleveland, OH USA
Measurements and Diagnostics of Diamond Films and Coatings
Miyoshi, Kazuhisa, NASA Glenn Research Center, USA; Wu, Richard L. C., K Systems Corp., USA; [1999]; 32p; In English; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The commercial potential of chemical-vapor-deposited (CVD) diamond films has been established and a number of applications have been identified through university, industry, and government research studies. This paper discusses the methodologies used for property measurement and diagnostic of CVD diamond films and coatings. Measurement and diagnostic techniques studied include scanning electron microscopy, transmission electron microscopy, atomic force microscopy, stylus profilometry, x-ray diffraction, electron diffraction, Raman spectroscopy, Rutherford backscattering, elastic recoil spectroscopy, and friction examination. Each measurement and diagnostic technique provides unique information. A combination of techniques can provide the technical information required to understand the quality and properties of CVD diamond films, which are important to their application in specific component systems and environments. In this study the combination of measurement and diagnostic techniques was successfully applied to correlate deposition parameters and resultant diamond film composition, crystallinity, grain size, surface roughness, and coefficient of friction.
Author
Diamond Films; Vapor Deposition; Transmission Electron Microscopy; Raman Spectroscopy; Electron Diffraction; Atomic Force Microscopy; Diagnosis

20010059027 NASA Marshall Space Flight Center, Huntsville, AL USA
Characterization of Carbon Nanotubes Grown by Chemical Vapor Deposition
Cochrane, J. C., Universities Space Research Association, USA; Zhu, Shen, Universities Space Research Association, USA; Su, Ching-Hua, NASA Marshall Space Flight Center, USA; Lehoczky, S. L., NASA Marshall Space Flight Center, USA; [2001]; 1p; In English; Proceedings of Microscopy and Microanalysis 2001, 5-9 Aug. 2001, Long Beach, CA, USA; No Copyright; Avail: Issuing Activity; Abstract Only

Since the superior properties of multi-wall carbon nanotubes (MWCNT) could improve numerous devices such as electronics and sensors, many efforts have been made in investigating the growth mechanism of MWCNT to synthesize high quality MWCNT. Chemical vapor deposition (CVD) is widely used for MWCNT synthesis, and scanning electron microscopy (SEM) and energy dispersive x-ray spectroscopy (EDS) are useful methods for analyzing the structure, morphology and composition of MWCNT. Temperature and pressure are two important growth parameters for fabricating carbon nanotubes. In MWCNT growth

by CVD, the plasma assisted method is normally used for low temperature growth. However a high temperature environment is required for thermal CVD. A systematic study of temperature and pressure-dependence is very helpful to understanding MWCNT growth. Transition metal particles are commonly used as catalysis in carbon nanotube growth. It is also interesting to know how temperature and pressure affect the interface of carbon species and catalyst particles
Author
Vapor Deposition; Nanotubes; Carbon; Catalysts; X Ray Spectroscopy; Scanning Electron Microscopy

20010059201 NASA Lewis Research Center, Cleveland, OH USA
Single Crystal Fibers of Yttria-Stabilized Cubic Zirconia with Ternary Oxide Additions
Ritzert, F. J., NASA Lewis Research Center, USA; Yun, H. M., NASA Lewis Research Center, USA; Miner, R. V., NASA Lewis Research Center, USA; [1997]; 35p; In English
Contract(s)/Grant(s): RTOP 523-21-13; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Single crystal fibers of yttria (Y2O3)-stabilized cubic zirconia, (ZrO2) with ternary oxide additions were grown using the laser float zone fiber processing technique. Ternary additions to the ZrO2-Y2O3 binary system were studied aimed at increasing strength while maintaining the high coefficient of thermal expansion of the binary system. Statistical methods aided in identifying the most promising ternary oxide candidate (Ta2O5, Sc2O3, and HfO2) and optimum composition. The yttria, range investigated was 14 to 24 mol % and the ternary oxide component ranged from 1 to 5 mol %. Hafnium oxide was the most promising ternary oxide component based on 816 C tensile strength results and ease of fabrication. The optimum composition for development was 81 ZrO2-14 Y203-5 HfO2 based upon the same elevated temperature strength tests. Preliminary results indicate process improvements could improve the fiber performance. We also investigated the effect of crystal orientation on strength.
Author
Yttria-Stabilized Zirconia; Single Crystals; Zirconium Oxides; Yttrium Oxides; High Temperature

20010059244 Universities Space Research Association, Huntsville, AL USA
Float Zone Growth of Alloy Semiconductor Crystals: Influence of Solutocapillary Convection
Dold, P., Freiburg Univ., Germany; Schweizer, M., NASA Marshall Space Flight Center, USA; Croell, A., Freiburg Univ., Germany; Campbell, T., Freiburg Univ., Germany; Boschert, S., Freiburg Univ., Germany; Benz, K. W., Freiburg Univ., Germany; [2001]; 1p; In English; ICCG13, 30 Jul. - 4 Aug. 2001, Kyoto, Japan
Contract(s)/Grant(s): NCC8-66; No Copyright; Avail: Issuing Activity; Abstract Only

Growth techniques with large free melt surfaces are affected by convective flows induced by gradients of the surface tension. In the case of dilute semiconductor alloys (in our case: germanium-silicon), the impact of solutocapillary convection (due to the concentration dependence of the surface tension) has to be taken into account in addition to the ”normal” thermocapillary convection (due to the temperature dependence of the surface tension). Theoretical considerations, based on experimental temperature profiles, growth geometry, segregation coefficient, and measured values for the temperature and concentration coefficients of the surface tension, lead to the conclusion that for the germanium rich side of the Ge(1-x)Si(x) system, the contribution of solutocapillary convection is, at least in front of the solid-liquid interface, the dominant factor. It results in an additional flow roll with a flow direction opposite to the thermocapillary flow, similar to the ones reported for metal alloys or high Prandtl-number fluids.
Author
Float Zones; Semiconductors (Materials); Crystal Growth; Convective Flow; Thermocapillary Migration; Zone Melting; Silicon; Interfacial Tension; Germanium

20010059348 Universities Space Research Association, Huntsville, AL USA
Measurement of Microscopic Growth Rates in Float-Zone Silicon Crystals
Dold, P., Freiburg Univ., Germany; Schweizer, M., NASA Marshall Space Flight Center, USA; Benz, K. W., Freiburg Univ., Germany; [2001]; 1p; In English; ICCG13, 30 Jul. - 4 Aug. 2001, Kyoto, Japan
Contract(s)/Grant(s): NCC8-66; No Copyright; Avail: Issuing Activity; Abstract Only

Time dependent convective flows during crystal growth of doped semiconductors lead to fluctuations of the composition, so called dopant striations. In general, it is difficult to decide which is the main mechanism for the generation of these striations, it might be either the fluctuation of the concentration field in the melt and the extent of the solute boundary layer ahead of the solid-liquid interface or a variation of the growth velocity. Direct access to the concentration field is rather complicated to achieve, especially considering the high process temperature and the chemical activity of liquid silicon. The contribution of growth rate fluctuations to the formation of compositional fluctuations can be determined by measuring microscopic growth rates. The classical method of current pulses requires electrical feed-throughs and good electrical contacts, both are critical issues for the

growth of high purity silicon crystals. Using a radiation based heating system, the heating power can be modulated very fast and effectively. We added to the normal heater power a sinusoidal off-set in the frequency range of 1 to 10 Hz, generating a narrow spaced weak rippling in the grown crystals which are superposed to the dopant striations caused by natural and by thermocapillary convection. The pulling speed was varied between 1 and 4mm/min. The microscope images of etched crystals slices have been analyzed by peak-search algorithms (measuring the spacing between each artificially induced marker) and by FFT. Performing growth experiments under a time-dependent flow regime, fluctuations of the microscopic growth velocity of Delta(v)/v(sub average) up to 50% have been measured. Damping the time-dependent convection by the use of an axial, static magnetic field of 500mT, the microscopic growth rate became constant within the resolution limit of this method. The results will be discussed using analytical methods for the calculation of microscopic growth velocity and by comparing them with measurements of temperature fluctuations in the melt during growth experiments itself.
Author
Crystal Growth; Doped Crystals; Semiconductors (Materials); Striation; Free Convection; Convective Flow

20010059349 NASA Marshall Space Flight Center, Huntsville, AL USA
Contact Angles and Surface Tension of Germanium-Silicon Melts
Croell, A., Freiburg Univ., Germany; Kaiser, N., Freiburg Univ., Germany; Cobb, S., NASA Marshall Space Flight Center, USA; Szofran, F. R., NASA Marshall Space Flight Center, USA; Volz, M., NASA Marshall Space Flight Center, USA; [2001]; 1p; In English; ICCG-13, 30 Jul. - 4 Aug. 2110, Kyoto, Japan; No Copyright; Avail: Issuing Activity; Abstract Only

Precise knowledge of material parameters is more and more important for improving crystal growth processes. Two important parameters are the contact (wetting) angle and the surface tension, determining meniscus shapes and surface-tension driven flows in a variety of methods (Czochralski, EFG, floating-zone, detached Bridgman growth). The sessile drop technique allows the measurement of both parameters simultaneously and has been used to measure the contact angles and the surface tension of Ge(1-x)Si(x) (0 less than or equal to x less than or equal to 1.3) alloys on various substrate materials. Fused quartz, Sapphire, glassy carbon, graphite, SiC, carbon-based aerogel, pyrolytic boron nitride (pBN), AIN, Si3N4, and polycrystalline CVD diamond were used as substrate materials. In addition, the effect of different cleaning procedures and surface treatments on the wetting behavior were investigated. Measurements were performed both under dynamic vacuum and gas atmospheres (argon or forming gas), with temperatures up to 1100 C. In some experiments, the sample was processed for longer times, up to a week, to investigate any changes of the contact angle and/or surface tension due to slow reactions with the substrate. For pure Ge, stable contact angles were found for carbon-based substrates and for pBN, for Ge(1-x)Si(x) only for pBN. The highest wetting angles were found for pBN substrates with angles around 170deg. For the surface tension of Ge, the most reliable values resulted in gamma(T) = (591-0.077 (T-T(sub m)) 10(exp -3)N/m. The temperature dependence of the surface tension showed similar values for Ge(1-x)Si(x), around -0.08 x 10(exp -3)N/m K, and a compositional dependence of 2.2 x 10(exp -3)N/m at%Si.
Author
Germanium; Silicon Nitrides; Melts (Crystal Growth); Surface Treatment; Crystal Growth; Glassy Carbon; Polycrystals; Interfacial Tension

20010059841 Universities Space Research Association, Huntsville, AL USA
Crystal Growth by Physical Vapor Transport: Experiments and Simulation Dynamics
Ramachandran, N., NASA Marshall Space Flight Center, USA; Worlikar, A., Cape Simulations, Inc., USA; Su, Ching-Hua, NASA Marshall Space Flight Center, USA; [2001]; 1p; In English; ICCG13, 30 Jul. - 4 Aug. 2001, Kyoto, Japan
Contract(s)/Grant(s): NCC8-66; No Copyright; Avail: Issuing Activity; Abstract Only

Crystal growth from the vapor phase has various advantages over melt growth. The main advantage is from a lower processing temperature, which makes the process more amenable in instances where the melting temperature of the crystal is high. Other benefits stem from the inherent purification mechanism in the process due to differences in the vapor pressures of the native elements and impurities, and the enhanced interfacial morphological stability during the growth process. Further, the implementation of PVT growth in closed ampoules affords experimental simplicity with minimal needs for complex process control, which makes it an ideal candidate for space investigations in systems where gravity tends to have undesirable effects on the growth process. Bulk growth of wide band gap II-VI semiconductors by PVT has been developed and refined over the past several years at NASA MSFC. A new modeling approach for PVT has also been recently formulated and its validation and testing is the main objective of this work.
Author
Crystal Growth; Vapor Phases; Vapor Pressure; Melts (Crystal Growth); Purification; Morphology

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SOCIAL AND INFORMATION SCIENCES (GENERAL)

Includes general research topics related to sociology; educational programs and curricula.

20010054942 New Horizons Regional Education Center, Hampton, VA USA
New Horizons Regional Education Center 2001 FIRST Robotics Competition ***Final Report***
[2001]; 4p; In English
Contract(s)/Grant(s): NCC1-01025; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

The New Horizons Regional Education Center (NHREC) in Hampton, VA sought and received NASA funding to support its participation in the 2001 FIRST Robotics competition. FIRST, Inc. (For Inspiration and Recognition of Science and Technology) is an organization which encourages the application of creative science, math, and computer science principles to solve real-world engineering problems. The FIRST competition is an international engineering contest featuring high school, government, and business partnerships.
Author
Competition; Robotics

20010056856 Savannah State Univ., Savannah, GA USA
Project Georgia High School/High Tech ***Annual Report, FY 1999-2000***
[2000]; 45p; In English; Original contains color illustrations; Sponsored by President's Com. on Employment of People with Disabilities, Georgia Div. of Rehabilitation Services, Dept. of Human Resources, Georgia Dept. of Labor, Georgia Dept. of Education and Georgia Govenor's Council on Developmental Disabilities; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Georgia High School/High Tech has been developing a suggested curriculum for use in its programs. The purpose of this instructional material is to provide a basic curriculum format for teachers of High School/High Tech students. The curriculum is designed to implement QCC classroom instruction that encourages career development in technological fields through post-secondary education, paid summer internships, and exposure to experiences in high technology.
Author
Education; Students; Technology Utilization

20010056928 NASA Ames Research Center, Moffett Field, CA USA
Two Practicing Adjuncts" Perspective on Flight Mechanics Education
Field, E. J., Boeing Phantom Works, USA; Schroeder, J. A., NASA Ames Research Center, USA; [2001]; 1p; In English; AIAA Atmospheric Flight Mechanics Conference, 6-9 Aug. 2001, Montreal, Canada; Sponsored by American Inst. of Aeronautics and Astronautics, USA; No Copyright; Avail: Issuing Activity; Abstract Only

In this paper, the authors provide their personal view of how flight mechanics is taught at universities. Their viewpoint is taken from a government and industry research and development bias, but it is tempered by their experience at teaching the subject at both an undergraduate and graduate level. First, the organizations' respective needs and their expectations of graduating students am presented both in general and with specific examples From this disposition, the question "is there a problem or not in present teaching methods or subject coverage?" is then considered. A review of previous positions on the topic is also covered. The paper concludes with suggested improvements based on the authors' experience.
Author
Flight Mechanics; Education; Organizations

20010059601 Smithsonian Astrophysical Observatory, Cambridge, MA USA
Funtools: Fits Users Need Tools for Quick, Quantitative Analysis ***Final Report, 1 May 2000 - 30 Apr. 2001***
Mandel, Eric, Smithsonian Astrophysical Observatory, USA; June 2001; 10p; In English
Contract(s)/Grant(s): NAG5-9484; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The Funtools project arose out of conversations with astronomers about the decline in their software development efforts over the past decade. A stated reason for this decline is that it takes too much effort to master one of the existing FITS libraries simply in order to write a few analysis programs. This problem is exacerbated by the fact that astronomers typically develop new programs only occasionally, and the long interval between coding efforts often necessitates re-learning the FITS interfaces. We therefore set ourselves the goal of developing a minimal buy-in FITS library for researchers who are occasional (but serious) coders. In this case, "minimal buy-in" meant "easy to learn, easy to use, and easy to re-learn next month". Based on conversations with astronomers interested in writing code, we concluded that this goal could be achieved by emphasizing two essential capabilities.

The first was the ability to write FITS programs without knowing much about FITS, i.e., without having to deal with the arcane rules for generating a properly formatted FITS file. The second was to support the use of already-familiar C/UNIX facilities, especially C structs and UNIX stdio. Taken together, these two capabilities would allow researchers to leverage their existing programming expertise while minimizing the need to learn new and complex coding rules.
Derived from text
Software Engineering; Coding; Computer Programming; Quantitative Analysis

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ADMINISTRATION AND MANAGEMENT

Includes management planning and research.

20010055654 National Tsing Hua Univ., Dept. of Industrial Engineering and Engineering Management, Hsinchu, Taiwan, Province of China
Inventory Lot-Size Policies for the Bass Diffusion Demand Models of New Durable Products
Chern, Maw-Sheng, National Tsing Hua Univ., Taiwan, Province of China; Teng, Jinn-Tsair, William Patterson Coll. of New Jersey, USA; Yang, Hui-Ling, Hung Kuang Inst. of Tech., Taiwan, Province of China; Journal of the Chinese Institute of Engineers; March 2001; ISSN 0253-3839; Volume 24, No. 2, pp. 237-244; In English
Contract(s)/Grant(s): NSC 89-2213-E-007-024; Copyright; Avail: Issuing Activity

The Bass model and its revised forms have been used for forecasting dynamic demand growth in retail service, industrial technology, consumer durable goods, and others. However, the inventory models currently available do not recognize the Bass diffusion demand pattern. In this paper, we first establish the necessary and sufficient conditions to solve the problem in determining the timing and number of replenishments for the Bass model. We then develop several fundamental theoretical results. Furthermore, a one-dimensional iterative method is proposed to find the optimal replenishment schedule. Finally, we provide an intuitively accurate estimate for the optimal number of replenishments, which significantly reduces computational complexity in finding the optimal replenishment number.
Author
Inventories; Policies; Diffusion Theory

20010056931 Environmental Protection Agency, Office of the Administrator, Washington, DC USA
Project XL: Directory of Regulatory, Policy, and Technology Innovations. 2000 Comprehensive Report, Volume 1
Nov. 2000; 128p; In English; Original contains color illustrations
Report No.(s): PB2001-105317; EPA/100/R-00/023A; No Copyright; Avail: National Technical Information Service (NTIS)

The Directory of Regulatory, Policy, and Technology Innovations describes more than 70 innovations being explored by Project XL. These innovations are catalogued by the core functions that are the fundamental processes and operations the U.S. Environmental Protection Agency must use in order to perform its mission to protect human health and the environment. Volume 1 presents technical and policy information relevant to each innovation.
NTIS
Environment Protection; Policies

20010058591 NASA Glenn Research Center, Cleveland, OH USA
CM and DM in an ISO R and D Environment
Crowley, Sandra L., NASA Glenn Research Center, USA; [2000]; 4p; In English
Contract(s)/Grant(s): RTOP 940-30-09-21; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

ISO 9000 - a common buzz word in industry is making inroads to government agencies. The National Aeronautics and Space Agency (NASA) achieved ISO 9001 certification at each of its nine (9) Centers and Headquarters in 1998-1999. NASA Glenn Research Center (GRC) was recommended for certification in September 1999. Since then, each of the Centers has been going through the semi-annual surveillance audits. Growing out of the manufacturing industry, successful application of the international quality standard to a research and development (R&D) environment has had its challenges. This paper will address how GRC applied Configuration Management (CM) and Data (or Document) Management (DM) to meet challenges to achieve ISO certification. One of the first challenges was to fit the ISO 9001-1994 elements to the GRC environment. Some of the elements fit well-Management Responsibility (4.1), Internal Audits (4.17), Document and Data Control (4.5). Other elements were not

suited or applied easily to the R&D environment-Servicing (4.19), Statistical Techniques (4.20). Since GRC ”builds” only one or two items at a time, these elements were considered not applicable to the environment.
Author
Configuration Management; Data Management; Words (Language); Statistical Analysis; Surveillance

20010058716 NASA Glenn Research Center, Cleveland, OH USA
Ubiquitous CM and DM
Crowley, Sandra L., NASA Glenn Research Center, USA; [2000]; 2p; In English
Contract(s)/Grant(s): RTOP 940-30-09-21; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

Ubiquitous is a real word. I thank a former Total Quality Coach for my first exposure some years ago to its existence. My version of Webster’s dictionary defines ubiquitous as ”present, or seeming to be present, everywhere at the same time; omnipresent.” While I believe that God is omnipresent, I have come to discover that CM and DM are present everywhere. Oh, yes; I define CM as Configuration Management and DM as either Data or Document Management. Ten years ago, I had my first introduction to the CM world. I had an opportunity to do CM for the Space Station effort at the NASA Lewis Research Center. I learned that CM was a discipline that had four areas of focus: identification, control, status accounting, and verification. I was certified as a CMIl graduate and was indoctrinated about clear, concise, and valid. Off I went into a world of entirely new experiences. I was exposed to change requests and change boards first hand. I also learned about implementation of changes, and then of technical and CM requirements.
Author
Configuration Management; Data Management; Words (Language)

20010059191 Environmental Protection Agency, Office of the Administrator, Washington, DC USA
Project XL: Directory of Project Experiments and Results. 2000 Comprehensive Report, Volume 2
Nov. 2000; 162p; In English; Original contains color illustrations
Report No.(s): PB2001-105318; EPA/100/R-00/023B; No Copyright; Avail: National Technical Information Service (NTIS)

This directory of Project Experiments and Results summarizes the more than 50 projects and project proposals Project XL has produced to date. The 16 projects that have been underway for a year or more are described in some detail, including, background, progress in meeting commitments, benefits for the environment, benefits for stakeholders, benefits for the project sponsor, spin-off benefits (where applicable), key issues needing resolution, lessons learned, and information resources. For the 37 projects in implementation for less than one year or still under development, only background information is given.
NTIS
Information Management; Technology Transfer; Directories; Project Management

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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.

20010055655 National Taiwan Univ. of Science and Technology, Dept. of Electrical Engineering, Taipei, Taiwan, Province of China
A Synchronization Model for Presentation of Multimedia Objects
Lin, In-Ho, National Taiwan Univ. of Science and Technology, Taiwan, Province of China; Lee, Bih-Hwang, National Taiwan Univ. of Science and Technology, Taiwan, Province of China; Wu, Chwan-Chia, National Taiwan Univ. of Science and Technology, Taiwan, Province of China; Journal of the Chinese Institute of Engineers; March 2001; ISSN 0253-3839; Volume 24, No. 2, pp. 173-186; In English; Copyright; Avail: Issuing Activity

To support the presentation requirements of distributed multimedia information, synchronization of multimedia objects must be achieved. to this end, system resource scheduling and resource reservation for object pre-fetch, network bandwidth and buffer occupancy must be determined prior to the time the presentation is initiated. This paper proposes an object-oriented model to handle the temporal relationship for all of the multimedia objects at the presentation platform and study the related problems of resource allocation. Synchronization of the composite media objects is achieved by ensuring that all objects presented in the upcoming ”manageable” period must be ready for execution. to this end, the nature of overlap is first examined for various types of objects. The importance of critical overlap and critical point that are vital to synchronization is addressed and taken into account in this research. The concept of manageable presentation interval and the irreducible media group are also introduced and defined.

Analysis of resource allocation among pre-fetch time of media object, network bandwidth and buffer occupancy is also examined. Accordingly, a new model called group cascade object composition Petri-net (GCOCPN) is proposed and an algorithm to implement this temporal synchronization scheme is presented.
Author
Synchronism; Multimedia; Object-Oriented Programming; Computer Programming; Algorithms

20010056269 Defence Science and Technology Organisation, Joint Systems Branch, Salisbury, Australia
Context Analysis and Principles Study, Phase 1, Client Report
Chen, P.; El-Sakka, A.; Oct. 2000; 79p; In English
Report No.(s): AD-A388623; DSTO-CR-0151-Phase-1-Pt-1; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

Large organizations are becoming increasingly dependent on the reliability, adaptability and interoperability of information-intensive systems to conduct their business operations successfully and profitably. These qualities are now prerequisite for organizations' survival in the ever-changing national and international markets. For the last two decades, architecture, despite its diverse definitions, has been considered by Information Technology (IT) practitioners and researchers, as playing critical roles during the life cycle of systems and their infrastructure. The roles include, firstly, providing a sound foundation on which quality information-intensive systems are developed or evolved, secondly, capturing the necessary knowledge to aid in the understanding about these systems, and thirdly, guiding the development of enterprise infrastructure needed to support the creation of such knowledge. This report concludes that large organizations, including the Australian Defense Organization (ADO), must commit themselves to establishing and managing architecture as an inseparable practice embedded within their overall IT management and practice. Such recommendation, once implemented, will ensure that the identified roles of architecture are performed, sustained and continually improved. to pave the way towards this objective, a conceptual model is introduced to help in the planning and guidance of the development and incorporation of architecture practice within ADO.
DTIC
Information Systems; Architecture (Computers); Systems Analysis

20010056395 NASA Ames Research Center, Moffett Field, CA USA
Automated Traffic Management System and Method
Glass, Brian J., Inventor, NASA Ames Research Center, USA; Spirkovska, Liljana, Inventor, NASA Ames Research Center, USA; McDermott, William J., Inventor, NASA Ames Research Center, USA; Reisman, Ronald J., Inventor, NASA Ames Research Center, USA; Gibson, James, Inventor, NASA Ames Research Center, USA; Iverson, David L., Inventor, NASA Ames Research Center, USA; Dec. 12, 2000; 26p; In English; Continuation-in-part of US-Patent-Appl-SN-908105, filed 11 Aug. 1997
Patent Info.: Filed 4 Jun. 1998; NASA-Case-ARC-14268-1; US-Patent-6,161,097; US-Patent-Appl-SN-090812; US-Patent-Appl-SN-908105; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A data management system and method that enables acquisition, integration, and management of real-time data generated at different rates, by multiple heterogeneous incompatible data sources. The system achieves this functionality by using an expert system to fuse data from a variety of airline, airport operations, ramp control, and air traffic control tower sources, to establish and update reference data values for every aircraft surface operation. The system may be configured as a real-time airport surface traffic management system (TMS) that electronically interconnects air traffic control, airline data, and airport operations data to facilitate information sharing and improve taxi queuing. In the TMS operational mode, empirical data shows substantial benefits in ramp operations for airlines, reducing departure taxi times by about one minute per aircraft in operational use, translating as $12 to $15 million per year savings to airlines at the Atlanta, Georgia airport. The data management system and method may also be used for scheduling the movement of multiple vehicles in other applications, such as marine vessels in harbors and ports, trucks or railroad cars in ports or shipping yards, and railroad cars in switching yards. Finally, the data management system and method may be used for managing containers at a shipping dock, stock on a factory floor or in a warehouse, or as a training tool for improving situational awareness of FAA tower controllers, ramp and airport operators, or commercial airline personnel in airfield surface operations.
Author
Air Traffic Control; Airline Operations; Data Management; Civil Aviation; Management Systems; Scheduling

20010057226 NASA Johnson Space Center, Houston, TX USA
Integration of the QMSFRG Database into the HZETRN Code
Cucinotta, F. A., NASA Johnson Space Center, USA; Shavers, M. R., Loma Linda Univ., USA; Tripathi, R. K., NASA Langley Research Center, USA; Wilson, J. W., NASA Langley Research Center, USA; Microgravity Materials Science Conference 2000; March 2001; Volume 1, pp. 149; In English; See also 20010057199; CD-ROM contains the entire Conference Proceedings

presented in PDF format; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

Accurate nuclear interaction data bases are needed for describing the transport of space radiation in matter including space craft structures, atmospheres, and tissues. Transport models support the identification and development of new material concepts for human and electronic part protection. Quantum effects are manifested in nuclear reactions in several ways including interference effects between terms in the multiple scattering series, the many-body nuclear wave functions (for e.g. the roles of shell structure and Fermi momentum) and nuclear clustering. The quantum multiple scattering fragmentation model (QMSFRG) is a comprehensive model for generating nuclear interaction databases for galactic cosmic ray (GCR) transport. Other nuclear databases including the NUCFRG model and Monte-Carlo simulation codes such as FLUKA, LAHET, HETC, and GEANT ignore quantum effects. These codes fail to describe many important features of nuclear reactions and are thus inaccurate for the evaluation of materials for radiation protection. Previously we have shown that quantum effects are manifested through constructive interference in forward production spectra, the effects of Fermi momentum on production spectra, cluster nuclei knockout, and the nuclear response function. Quantum effects are especially important for heavy ions with mass numbers less than 20 that dominate radiation transport in human tissues and for the materials that are expected to be superior in space radiation protection. We describe the integration of the QMSFRG model into the HZETRN transport code. Integration milestones include proper treatment of odd-even charge-mass effects in nuclear fragmentation and the momentum distribution of nucleon production from GCR primary heavy ions. We have also modified the two-body amplitudes in the model to include nuclear medium effects. In order to include a comprehensive description of the GCR isotopic composition in materials, we have described the isotopic composition of the GCR by extending the 59-isotope version of HZETRN to an 120-isotope version. The isotopic composition of most primary GCR elements (including H, He, C, N, O, Ne, Mg, Si, Ar, Ca, Cr, and Fe) are included in the extended model. We discuss results for the high-energy neutron composition inside materials, and the charge and mass distribution for benchmark GCR problems.

Author

Data Bases; Applications Programs (Computers); Galactic Cosmic Rays; Radiation Transport; Nuclear Particles; Nuclear Interactions

20010059206 Research and Technology Organization, Information Systems Technology Panel, Neuilly-sur-Seine, France

Visualisation of Massive Military Datasets: Human Factors, Applications, and Technologies ***Final Report la Visualisation d'Ensembles Volumineux de Donnees Militaires: Facteurs Humanins, Applications et Technologies***

May 2001; 162p; In English; Original contains color illustrations

Report No.(s): RTO-TR-030; AC/323(IST-013)TP/9; IST-013/RTG-002; ISBN 92-837-1066-5; Copyright Waived; Avail: CASI; C01, CD-ROM; A08, Hardcopy; A02, Microfiche

This final report of IST-013/RTG-002 "Visualization of Massive Military Datasets" presents some of the issues involved in visualisation as well as techniques that have been used in support of visualization for military applications. These issues are examined from three viewpoints: issues relating to human abilities and requirements, issues of data and of display technology, and issues relating to exemplary applications. Visualisation is seen to be something that happens in the mind of a human, not on the screen of a display. Effective visualization requires the users to interact closely with visual, auditory and perhaps haptic displays. IST-013/RTG-002 has accepted a reference model developed by IST-005, its predecessor group. The IST-005 Reference Model describes three loops of interaction between human and machine, an outermost loop that is the "Why", a middle loop that is the "What", and an inner loop that is the "How" of visualisation. Since it is the human who visualizes, the central questions concern the human factors of the visualisation process. Important among these questions are the purposes of the users, together with the sensory and cognitive capabilities and limitations of humans. We identify four classes of purpose: Monitoring/controlling, Alerting, Searching, and Exploring. These purposes have different implications for the displays and the input devices, as well as for the engines that process the data. Chapter 3 of this report attempts a simple taxonomy of the kinds of data that might be involved in visualization. Finally, it is not enough simply to construct a visualisation system. It must be evaluated. Chapter 8 of the report discusses how this may be done.

Author

Data Processing; Display Devices; Human Factors Engineering; Data Bases

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ASTRONOMY

Includes observations of celestial bodies, astronomical instruments and techniques; radio, gamma-ray, x-ray, ultraviolet, and infrared astronomy; and astrometry.

20010056393 Southwest Research Inst., San Antonio, TX USA
Ground-Based IR Spectroscopy of Mercury for Composition, *15 Mar. 1998 - 14 Mar. 2001*
Killen, Rosemary M., Southwest Research Inst., USA; [2001]; 2p; In English
Contract(s)/Grant(s): NAG5-4167; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

Remote sensing measurements of the Moon and Mercury in the thermal infrared have been plagued with problems due to atmospheric absorption and other effects. Controversial results have been discussed by Nash et al. and by Salisbury et al.. We have developed a technique to obtain thermal infrared spectra of Mercury together with solar and sky spectra in the 8-13 micrometer region suitable for determining the presence or absence of mineralogical features. High-resolution (0.05 cm(exp -1) between data points) spectra were obtained during daylight using the Fourier Transform Spectrograph (FTS) at the McMath-Pierce Solar Telescope Facility at Kitt Peak National Observatory, Arizona. The reduced data were independent of any model of the transmission of the Earth's atmosphere and rest on a calibration using sky spectra along the same line-of-sight through the atmosphere as the actual Mercury raw spectrum. This method can be applied at all solar elongation angles including small elongation angles (5 deg or less). The basic sequence and the technique are robust.
Derived from text
Mercury (Planet); Mineralogy; Infrared Spectra

20010056610 NASA Goddard Space Flight Center, Greenbelt, MD USA
High-Resolution X-Ray Spectroscopy of the Seyfert 2 Galaxy Circinus with Chandra
Sambruna, Rita M., Pennsylvania State Univ., USA; Netzer, Hagai, Tel-Aviv Univ., Ramat-Aviv, Israel; Kaspi, Shai, Pennsylvania State Univ., USA; Brandt, W. N., Pennsylvania State Univ., USA; Chartas, G., Pennsylvania State Univ., USA; Garmire, G. P., Pennsylvania State Univ., USA; Nousek, John A., Pennsylvania State Univ., USA; Weaver, K. A., NASA Goddard Space Flight Center, USA; Apr. 09, 2000; 4p; In English; Sponsored in part by the Israel Science Foundation
Contract(s)/Grant(s): NAS8-38252; NAG5-7276; NAG5-8107; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

Results from a 60 ks Chandra High Energy Transmission Grating Spectrometer (HETGS) observation of the nearby Seyfert 2 Circinus are presented. The spectrum shows a wealth of emission lines at both soft and hard X-rays, including lines of Ne, Mg, Si, S, Ar, Ca, and Fe, and a prominent Fe K(alpha) line at 6.4 keV. We identify several of the He-like components and measure several of the Lyman lines of the N-like ions. The lines' profiles are unresolved at the limited signal-to-noise ratio of the data. Our analysis of the zeroth-order image in a companion paper constrains the size of the emission region to be 20-60 pc, suggesting that emission within this volume is almost entirely due to the reprocessing of the obscured central source. Here we show that a model containing two distinct components can reproduce almost all the observed properties of this gas. The ionized component can explain the observed intensities of the ionized species, assuming twice-solar composition and an N is proportional r(exp -1.5) density distribution. The neutral component is highly concentrated, well within the 0.8" point source, and is responsible for almost all of the observed K(alpha) (6.4 keV) emission. Circinus seems to be different than Mkn 3 in terms of its gas distribution.
Author
Seyfert Galaxies; Emission Spectra; X Ray Astronomy

20010059304 NASA Goddard Space Flight Center, Greenbelt, MD USA
Microlensing: Globular Cluster M22 Video File
[2001]; In English; Videotape: 6 min. 55 sec. playing time, in color, with sound
Report No.(s): NONP-NASA-VT-2001092796; No Copyright; Avail: CASI; B01, Videotape-Beta; V01, Videotape-VHS

A computerized animation begins outside a globular cluster similar to M22, with the center of the Milky Way in the distance. The camera flies through the center of the cluster and rests with a dark object in the distance. This object, a suspected brown star, passes in front of a star in the galactic bulge, bending its light gravitationally. This bending, or lensing, causes a momentary brightening of the background star. Another sequence begins with a ground-based view of the center of our galaxy in the upper right. We zoom in to reveal a ground-based view of the region surrounding the cluster and continue zooming to reveal the Hubble Space Telescope view of M22. In an interview with Kailash Sahu, Astronomer, he describes the Hubble results, explains why the objects in M22 can't be planets, and explains Hubble's role in the observations of M22. The last image was taken with Hubble's

Wide Field and Planetary Camera 2 and pierces the heart of a globular cluster with its needle-sharp vision and uncovers tantalizing clues to what could potentially be a strange and unexpected population of wandering, planet-sized objects.
Author
Globular Clusters; Gravitational Lenses; Milky Way Galaxy

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ASTROPHYSICS

Includes cosmology; celestial mechanics; space plasmas; and interstellar and interplanetary gases and dust.

20010054955 NASA Marshall Space Flight Center, Huntsville, AL USA
A Recommended Procedure for Estimating the Cosmic-Ray Spectral Parameter of a Simple Power Law With Applications to Detector Design
Howell, L. W., NASA Marshall Space Flight Center, USA; May 2001; 42p; In English
Report No.(s): NASA/TP-2001-210989; M-1015; NAS 1.60:210989; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A simple power law model consisting of a single spectral index alpha-1 is believed to be an adequate description of the galactic cosmic-ray (GCR) proton flux at energies below 10(exp 13) eV. Two procedures for estimating alpha-1 the method of moments and maximum likelihood (ML), are developed and their statistical performance compared. It is concluded that the ML procedure attains the most desirable statistical properties and is hence the recommended statistical estimation procedure for estimating alpha-1. The ML procedure is then generalized for application to a set of real cosmic-ray data and thereby makes this approach applicable to existing cosmic-ray data sets. Several other important results, such as the relationship between collecting power and detector energy resolution, as well as inclusion of a non-Gaussian detector response function, are presented. These results have many practical benefits in the design phase of a cosmic-ray detector as they permit instrument developers to make important trade studies in design parameters as a function of one of the science objectives. This is particularly important for space-based detectors where physical parameters, such as dimension and weight, impose rigorous practical limits to the design envelope.
Author
Cosmic Rays; Maximum Likelihood Estimates; Energy Spectra; Statistical Analysis

20010054957 NASA Marshall Space Flight Center, Huntsville, AL USA
Estimating Cosmic-Ray Spectral Parameters from Simulated Detector Responses with Detector Design Implications
Howell, L. W., NASA Marshall Space Flight Center, USA; April 2001; 114p; In English
Report No.(s): NASA/TP-2001-210962; M-1014; NAS 1.60:210962; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

A simple power law model consisting of a single spectral index (alpha-1) is believed to be an adequate description of the galactic cosmic-ray (GCR) proton flux at energies below 10(exp 13) eV, with a transition at knee energy (E(sub k)) to a steeper spectral index alpha-2 is greater than alpha-1 above E(sub k). The maximum likelihood procedure is developed for estimating these three spectral parameters of the broken power law energy spectrum from simulated detector responses. These estimates and their surrounding statistical uncertainty are being used to derive the requirements in energy resolution, calorimeter size, and energy response of a proposed sampling calorimeter for the Advanced Cosmic-ray Composition Experiment for the Space Station (ACCESS). This study thereby permits instrument developers to make important trade studies in design parameters as a function of the science objectives, which is particularly important for space-based detectors where physical parameters, such as dimension and weight, impose rigorous practical limits to the design envelope.
Author
Cosmic Rays; Maximum Likelihood Estimates; Spectrum Analysis; Radiation Detectors

20010056690 NASA Ames Research Center, Moffett Field, CA USA
Photoevaporation of Disks Around Young Stars: Application to Ultracompact HII Regions, Proplyds, and the Solar Nebula
Hollenbach, David, NASA Ames Research Center, USA; [2001]; 1p; In English, 27 Feb. 2001, San Diego, CA, USA
Contract(s)/Grant(s): RTOP 344-04-10-02; No Copyright; Avail: Issuing Activity; Abstract Only

Young massive stars produce sufficient Lyman continuum photon luminosity to significantly affect the structure and evolution of the accretion disks surrounding them. A nearly static, ionized, isothermal 10’ K atmosphere forms above the neutral disk, creating a photoevaporative flow from the outer parts of the disk. The resulting slow (10-50 km/s) ionized outflow, which

persists for greater than or approximately 10(exp 5) years for disk masses M(sub d) to approximately 0.3M(sub *), may explain the observational characteristics of many ultracompact HII regions. We compare model results to the observed radio free-free spectra and luminosities of ultracompact HII regions and to the interesting source MWC349, which is observed to produce hydrogen masers. We also apply the results to the early solar nebula to explain the the dispersal of the solar nebula and the differences in hydrogen content in the giant planets. Finally, we model the small bright objects (”proplyds”) observed in the Orion Nebula as disks around young, low mass stars which axe externally illuminated by the UV photons from the nearby massive star theta(sup 1)C.
Author
Planetary Nebulae; Accretion Disks; Stellar Mass; H II Regions; Massive Stars

20010056935 Salk Inst. for Biological Studies, San Diego, CA USA
Sample Return from Small Solar System Bodies
Orgel, L., Salk Inst. for Biological Studies, USA; AHearn, M., Maryland Univ., USA; Bada, J., Scripps Institution of Oceanography, USA; Baross, J., Washington Univ., USA; Chapman, C., Southwest Research Inst., USA; Drake, M., Arizona Univ., USA; Kerridge, J., California Univ., San Diego, USA; Race, M., Search for Extraterrestrial Intelligence Inst., USA; Sogin, M., Woods Hole Research Center, USA; Squyres, S., Cornell Univ., USA; Advances in Space Research; 2000; ISSN 0273-1177; Volume 25, No. 2, pp. 239-248; In English; Copyright; Avail: Issuing Activity

With plans for multiple sample return missions in the next decade, NASA requested guidance from the National Research Council’s SSB on how to treat samples returned from solar system bodies such as planetary satellites, asteroids, and comets. A special Task Group assessed the potential for a living entity to be included in return samples from various bodies as well as the potential for large scale effects if such an entity were inadvertently introduced into the Earth’s biosphere. The Group also assessed differences among solar system bodies, identified investigations that could reduce uncertainty about the bodies, and considered risks of returned samples compared to natural influx of material to the Earth in the form of interplanetary dust particles, meteorites, and other small impactors. The final report provides a decision making framework for future missions and makes recommendations on how to handle samples from different planetary satellites and primitive solar system bodies.
Author
Sample Return Missions; Risk; Samples; Containment

20010057605 Arizona State Univ., Tempe, AZ USA
Nova Outburst: Thermonuclear Runaways on Degenerated Dwarfs
Starrfield, Sumner, Arizona State Univ., USA; Truran, James W., Chicago Univ., USA; Sparks, W. M., XNH; 2001; 14p; In English; Proceedings of Cataclysmic Variables: A 60th Birthday Symposium in honour of Brian Warner
Report No.(s): PB2001-105592; LA-UR-99-3305; No Copyright; Avail: CASI; A01, Microfiche; A03, Hardcopy

Observational and theoretical studies of the outbursts of classical novae have provided critical insights into a broad range of astrophysical phenomena. Thermonuclear runaways (TNRs) in accreted hydrogen-rich envelopes on the white dwarf (WD) components of close binary systems constitute not only the outburst mechanismn for a classical nova explosion, but also for recurrent novae and a fraction of the symbiotic novae explosions. Studies of the general characteristics of these explosions, both in our own galaxy and in neighboring galaxies of varying metallcity, can teach us about binary stellar evolution, while studies of the evolution of nova binary systems can constrain models for the (as yet unidentified) progenitors of Type Ia supernovae. Further, the empiricaI relation between the peak luminosity of a nova and the rate of decline, which presents a challenge to theoretical models, allows novae to be utilized as standard candles for distance determinations out to the Virgo Cluster, Extensive studies of novae with IUE and the resulting abundance determinations have revealed the existence of oxygen-neon white dwarfs in some systems. The high levels of enrichment of novae ejecta in elements ranging from carbon to sulfur confirm that there is significant dredge-up of matter from the core of the underlying white dwarf and enable novae to contribute to the chemical enrichment of the interstellar medium.
NTIS
Interstellar Matter; Thermonuclear Reactions; Astrophysics; Binary Stars; Dwarf Novae; Supernovae; White Dwarf Stars

20010057779 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA USA
Origin and Evolution of the Unusual Object 1996 PW: Asteroids from the Oort Cloud?
Weissman, Paul R., Jet Propulsion Lab., California Inst. of Tech., USA; Levison, Harold F., Southwest Research Inst., USA; Astrophysical Journal; Oct. 20, 1997; Volume 488, pp. L133-L136; In English; Copyright; Avail: Issuing Activity

The unusual object 1996 PW was discovered on 1996 August 9 by the Near-Earth Asteroid Tracking automated search camera operating from Haleakala in Hawaii. Although asteroidal in appearance, it was soon determined that the object is in a

near-parabolic orbit similar to that of a long-period comet. No object that was not an active comet has ever been discovered on such an eccentric orbit. The discovery of 1996 PW prompted us to examine and evaluate its possible origins, including the intriguing possibility that it is an asteroid from the Oort cloud. Current models for the formation of the Oort cloud argue that most of the material there should be from the Uranus-Neptune region and thus cometary, not asteroidal, in composition. We better quantify these models and show that approximately 1% of the Oort Cloud population should be asteroids. We find that 1996 PW has almost certainly been a resident of the Oort cloud. However, we find it equally likely that 1996 PW is an extinct comet or an asteroid. Although not conclusive, our results represent a significant change in our understanding of the Oort cloud, because they suggest that the ejection process sampled material from as close to the Sun as the asteroid belt in the primordial solar nebula and hence much warmer formation temperatures than previously thought. This diverse sample is preserved in the Oort cloud.
Author
Asteroids; Oort Cloud; Eccentric Orbits; Dynamic Tests

20010059864 NASA Ames Research Center, Moffett Field, CA USA
Stardust to Planetesimals: A Chondrule Connection?
Paque, Julie, Search for Extraterrestrial Intelligence Inst., USA; Bunch, Ted, NASA Ames Research Center, USA; From Stardust to Planetesimals: ASP Conference Series; [1997]; Volume 122, pp. 253-268; In English; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The unique nature of chondrules has been known for nearly two centuries. Modern techniques of analysis have shown that these millimeter sized silicate objects are among the oldest objects in our solar system. Researchers have devised textural and chemical classification systems for chondrules in an effort to determine their origins. It is agreed that most chondrules were molten at some point in their history, and experimental analogs suggest that the majority of chondrules formed from temperatures below 1600 C at cooling rates in the range of hundreds of degrees per hour. Although interstellar grains are present in chondrite matrices, their contribution as precursors to chondrule formation is unknown. Models for chondrule formation focus on the pre-planetary solar nebula conditions, although planetary impact models have had proponents.
Author
Chondrule; Meteoritic Composition; Interstellar Matter; Chemical Composition

20010059877 NASA Johnson Space Center, Houston, TX USA
On the Lower Limit of Chondrule Cooling Rates: The Significance of Iron Loss in Dynamic Crystallization Experiments ***Final Report***
Paque, Julie M., Search for Extraterrestrial Intelligence Inst., USA; Connolly, Harold C., Jr., California Inst. of Tech., USA; Lofgren, Gary E., NASA Johnson Space Center, USA; [1998]; 13p; In English
Contract(s)/Grant(s): NCC2-887; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

It is unlikely that the presence of chondrules, and thus their formation, within the protoplanetary nebula would be predicted if it were not for their ubiquitous presence in most chondritic meteorites. The study of these enigmatic, igneous objects has a direct influence on how meteoritic and solar system researchers model the processes operating and the materials present within our protoplanetary nebula. Key to understanding chondrule formation is a determination of constraints on their thermal histories. The three important variables in this history are their peak melting temperatures, the duration of their melting at peak temperatures, and the rate at which these object cool. Although these three variables are interdependent, it is cooling rate that provides the most powerful constraint. Cooling rate has a direct affect on the development of both crystal morphology and the elemental distributions within these grains. to date, experiments have indicated that chondrule cooling rates are in the range of 10's to 100's of degrees per hour for porphyritic chondrules (the most abundant type). The cooling rate for radial and barred chondrules is thought to be more rapid. to generate these cooling rates (rapid relative to the cooling of the nebula as a whole, but slow compared to simple black body radiation) the environment of chondrule formation must have been localized, and the abundance of solid materials must have been greatly enhanced above a gas of solar composition. Thus accurate determinations of chondrule cooling rates is critical in understanding both their formation and the nebular environment in which they formed. In a quest to more accurately determine the lower limit on cooling rates and to determine in more detail the effects of Fe loss from a molten sample to Pt wire loops, Weinbruch et al. have explored this issue experimentally and reevaluated the findings of Radomsky and Hewins in light of their new results. The basic conclusions of their paper are an important contribution to our understanding of how experimental techniques can affect established constraints on chondrule formation and are thus of interest to a wide audience. We do believe, however, that their methodology produces results that provide inappropriate impressions of the applicability of their study to chondrule formation and nebular processes. Furthermore, the extensive body of previous experimental work on chondrule bulk compositions cannot be invalidated, as they suggest, by the results of Weinbruch et al. It is for these reasons that within this

comment we address to applicability of the results presented by Weinbruch et al. to previous studies, and illustrate how the experimental conditions chosen for their series of experiments introduced a significant bias in their results.
Derived from text
Chondrule; Cooling; Crystallization; Chondrites; Experimentation; Iron

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LUNAR AND PLANETARY SCIENCE AND EXPLORATION

Includes planetology; selenology; meteorites; comets; and manned and unmanned planetary and lunar flights. For spacecraft design or space stations see 18 Spacecraft Design, Testing and Performance.

20010055260 Southwest Research Inst., Space Science and Engineering Div., San Antonio, TX USA
Low Energy Electrons in the Mars Plasma Environment ***Final Report***
Link, Richard, Southwest Research Inst., USA; May 23, 2001; 30p; In English
Contract(s)/Grant(s): NAG5-9608; SwRI Proj. 15-03805; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The ionosphere of Mars is rather poorly understood. The only direct measurements were performed by the Viking 1 and 2 landers in 1976, both of which carried a Retarding Potential Analyzer. The RPA was designed to measure ion properties during the descent, although electron fluxes were estimated from changes in the ion currents. Using these derived low-energy electron fluxes, Mantas and Hanson studied the photoelectron and the solar wind electron interactions with the atmosphere and ionosphere of Mars. Unanswered questions remain regarding the origin of the low-energy electron fluxes in the vicinity of the Mars plasma boundary. Crider, in an analysis of Mars Global Surveyor Magnetometer/Electron Reflectometer measurements, has attributed the formation of the magnetic pile-up boundary to electron impact ionization of exospheric neutral species by solar wind electrons. However, the role of photoelectrons escaping from the lower ionosphere was not determined. In the proposed work, we will examine the role of solar wind and ionospheric photoelectrons in producing ionization in the upper ionosphere of Mars. Low-energy (is less than 4 keV) electrons will be modeled using the two-stream electron transport code of Link. The code models both external (solar wind) and internal (photoelectron) sources of ionization, and accounts for Auger electron production. The code will be used to analyze Mars Global Surveyor measurements of solar wind and photoelectrons down to altitudes below 200 km in the Mars ionosphere, in order to determine the relative roles of solar wind and escaping photoelectrons in maintaining plasma densities in the region of the Mars plasma boundary.
Author
Photoelectrons; Solar Wind; Mars Atmosphere; Planetary Ionospheres; Electron Scattering

20010056271 NASA Ames Research Center, Moffett Field, CA USA
Carbon Dioxide Clouds at High Altitude in the Tropics and in an Early Dense Martian Atmosphere
Colaprete, Anthony, NASA Ames Research Center, USA; Toon, Owen B., Colorado Univ., USA; February 2001; 54p; In English; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

We use a time dependent, microphysical cloud model to study the formation of carbon dioxide clouds in the Martian atmosphere. Laboratory studies by Glandor et al. show that high critical supersaturations are required for cloud particle nucleation and that surface kinetic growth is not limited. These conditions, which are similar to those for cirrus clouds on Earth, lead to the formation of carbon dioxide ice particles with radii greater than 500 micrometers and concentrations of less than 0.1 cm(exp -3) for typical atmospheric conditions. Within the current Martian atmosphere, CO2 cloud formation is possible at the poles during winter and at high altitudes in the tropics during periods of increased atmospheric dust loading. In both cases, temperature perturbations of several degrees below the CO2 saturation temperature are required to nucleate new cloud particles suggesting that dynamical processes are the most common initiators of carbon dioxide clouds rather than diabatic cooling. The microphysical cloud model, coupled to a two-stream radiative transfer model, is used to reexamine the impact of CO2 clouds on the surface temperature within a dense CO2 atmosphere. The formation of carbon dioxide clouds leads to a warmer surface than what would be expected for clear sky conditions. The amount of warming is sensitive to the presence of dust and water vapor in the atmosphere, both of which act to dampen cloud effects. The radiative warming associated with cloud formation, as well as latent heating, work to dissipate the clouds when present. Thus, clouds never last for periods much longer than several days, limiting their overall effectiveness for warming the surface. The time average cloud optical depth is approximately unity leading to a 5-10 K warming, depending on the surface pressure. However, the surface temperature does not rise about the freezing point of liquid water even for pressures as high as 5 bars, at a solar luminosity of 75% the current value.
Author
Atmospheric Models; Carbon Dioxide; Clouds (Meteorology); Mars Atmosphere

20010056494 Lunar and Planetary Inst., Houston, TX USA

Workshop on Science and the Human Exploration of Mars

Duke, M. B., Editor, Lunar and Planetary Inst., USA; 2001; 196p; In English, 11-12 Jan. 2001, Greenbelt, MD, USA; See also 20010056495 through 20010056512

Contract(s)/Grant(s): NASW-4574

Report No.(s): LPI-Contrib-1089; No Copyright; Avail: CASI; A09, Hardcopy; A03, Microfiche

The exploration of Mars will be a multi-decadal activity. Currently, a scientific program is underway, sponsored by NASA's Office of Space Science in the USA, in collaboration with international partners France, Italy, and the European Space Agency. Plans exist for the continuation of this robotic program through the first automated return of Martian samples in 2014. Mars is also a prime long-term objective for human exploration, and within NASA, efforts are being made to provide the best integration of the robotic program and future human exploration missions. From the perspective of human exploration missions, it is important to understand the scientific objectives of human missions, in order to design the appropriate systems, tools, and operational capabilities to maximize science on those missions. In addition, data from the robotic missions can provide critical environmental data - surface morphology, materials composition, evaluations of potential toxicity of surface materials, radiation, electrical and other physical properties of the Martian environment, and assessments of the probability that humans would encounter Martian life forms. Understanding of the data needs can lead to the definition of experiments that can be done in the near-term that will make the design of human missions more effective. This workshop was convened to begin a dialog between the scientific community that is central to the robotic exploration mission program and a set of experts in systems and technologies that are critical to human exploration missions. The charge to the workshop was to develop an understanding of the types of scientific exploration that would be best suited to the human exploration missions and the capabilities and limitations of human explorers in undertaking science on those missions.

Derived from text

Mars (Planet); Mars Exploration; Aerospace Sciences

20010056495 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA USA

Relative Roles of Robots and Humans in the Exploration of Mars

Golombek, M., Jet Propulsion Lab., California Inst. of Tech., USA; Workshop on Science and the Human Exploration of Mars; 2001, pp. 27-38; In English; See also 20010056494; No Copyright; Avail: CASI; A03, Hardcopy; A03, Microfiche

The role of robots and humans in Mars Exploration is presented.

CASI

Mars Exploration; Robots; Mars (Planet)

20010056496 Arizona State Univ., AZ USA

Problem Statement: Geology-Geophysics Goal. Objectives and Investigations for Mars Exploration

Greeley, Ronald, Arizona State Univ., USA; Workshop on Science and the Human Exploration of Mars; 2001, pp. 39-44; In English; See also 20010056494; No Copyright; Avail: CASI; A02, Hardcopy; A03, Microfiche

The geology-geophysics of Mars is presented.

CASI

Geophysics; Mars Exploration; Planetary Geology; Mars (Planet)

20010056497 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA USA

Mars Climate: Science Opportunities and Operational Dependence for Human Explorers

McCleese, Dan, Jet Propulsion Lab., California Inst. of Tech., USA; Workshop on Science and the Human Exploration of Mars; 2001, pp. 47-57; In English; See also 20010056494; No Copyright; Avail: CASI; A03, Hardcopy; A03, Microfiche

Mars climatology and its influence on human exploration is presented.

CASI

Climatology; Mars Atmosphere; Mars (Planet)

20010056499 NASA Johnson Space Center, Houston, TX USA

Science and the Human Exploration of Mars: Risks to the Crew on the Surface

Charles, John B., NASA Johnson Space Center, USA; Sullivan, Thomas A., NASA Johnson Space Center, USA; Workshop on Science and the Human Exploration of Mars; 2001, pp. 60-68; In English; See also 20010056494; No Copyright; Avail: CASI; A02, Hardcopy; A03, Microfiche

The contents include: 1) Crew Autonomy; 2) Bioastronautics Critical Path Roadmap (CPR); 3) CPR Issues; and 4) Clinical Problems.
CASI
Bioastronautics; Spacecrews; Mars Surface

20010056500 NASA Johnson Space Center, Houston, TX USA
EVA Considerations
Fullerton, R., NASA Johnson Space Center, USA; Workshop on Science and the Human Exploration of Mars; 2001, pp. 69-77; In English; See also 20010056494; No Copyright; Avail: CASI; A02, Hardcopy; A03, Microfiche

The contents include: 1) Human Contributions; 2) Tasks for Humans (History and Future); 3) Environmental and Physical Limitations; 4) Human and Robotic Implementation Options; 5) Ground Test Experience; 6) Needed Enabling Information and Technology; and 7) Strategic Issues.
CASI
Extravehicular Activity; Mars Exploration; Mars Surface

20010056501 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA USA
Robot and Human Surface Operations on Solar System Bodies
Weisbin, C. R., Jet Propulsion Lab., California Inst. of Tech., USA; Easter, R., Jet Propulsion Lab., California Inst. of Tech., USA; Rodriguez, G., Jet Propulsion Lab., California Inst. of Tech., USA; Workshop on Science and the Human Exploration of Mars; 2001, pp. 78-88; In English; See also 20010056494; No Copyright; Avail: CASI; A03, Hardcopy; A03, Microfiche

This paper presents a comparison of robot and human surface operations on solar system bodies. The topics include: 1) Long Range Vision of Surface Scenarios; 2) Human and Robots Complement Each Other; 3) Respective Human and Robot Strengths; 4) Need More In-Depth Quantitative Analysis; 5) Projected Study Objectives; 6) Analysis Process Summary; 7) Mission Scenarios Decompose into Primitive Tasks; 7) Features of the Projected Analysis Approach; and 8) The ”Getting There Effect” is a Major Consideration. This paper is in viewgraph form.
CASI
Robots; Solar System; Mars Surface

20010056502 NASA Goddard Space Flight Center, Greenbelt, MD USA
Human Mars Mission Contamination Issues
Lupisella, M. L., NASA Goddard Space Flight Center, USA; Workshop on Science and the Human Exploration of Mars; 2001, pp. 89-91; In English; See also 20010056494; No Copyright; Avail: CASI; A01, Hardcopy; A03, Microfiche

A potential challenge for a human Mars mission is that while humans are by most measures the obvious best way to search for life on Mars, we may also be the most problematic in that we could unduly compromise the search for life by contaminating relevant environments and/or possibly adversely and irreversibly affecting indigenous life. Perhaps more problematic is the fundamental epistemic challenge of the ”one data point” limitation which could decrease confidence in applying terrestrially based research to extraterrestrial life issues in general. An informal decision tree is presented as one way to begin thinking about contamination issues. There are many sub-questions and distinctions not shown such as biological vs. nonbiological (but biologically relevant) contamination, viable vs. dead organisms, masking indigenous organisms vs. merely making the search more difficult, and independent origin vs. panspermia distinctions. While it may be unlikely that terrestrial microbes could survive on Mars, let alone reproduce and unduly compromise the search for life, the unpredictable potential for microbial life to survive, grow exponentially, evolve and modify (and sometimes destroy) environments, warrants focusing carefully on biologically relevant contamination as we prepare to send humans to the first planet that may have indigenous life-forms.
Derived from text
Mars (Planet); Contamination; Manned Mars Missions

20010056503 Maryland Univ., Space Systems Lab., MD USA
Cooperative EVA/Telerobotic Surface Operations in Support of Exploration Science
Akin, David L., Maryland Univ., USA; Workshop on Science and the Human Exploration of Mars; 2001, pp. 92-118; In English; See also 20010056494; No Copyright; Avail: CASI; A03, Hardcopy; A03, Microfiche

The contents include: 1) Planetary Surface Robotics; 2) EVA Difficulties from Apollo; 3) Robotic Capabilities for EVA Support; 4) Astronaut Support Vehicle; 5) Three ASV Preliminary Designs; 6) Small Single-arm Assistant; 7) Dual-arm Assistant; 8) Large EVA Assistant; 9) Lessons Learned-Preliminary Designs; 10) Rover Design Assumptions; 11) Design Requirements-Terrain; 12) Design Requirements; 13) Science Payload; 14) Manipulator Arm; 15) EVA Multiple Robot

Cooperation; 16) SSL Rover Body Concept; 17) Advanced EVA Support Rover Concept; 18) Robotic Access to Restricted Sites; 19) Robotic Rescue of EVA crew; and 19) Why Do We Need Humans? This paper is presented in viewgraph form.
CASI
Extravehicular Activity; Telerobotics; Planetary Surfaces

20010056504 NASA Ames Research Center, Moffett Field, CA USA
Analog Studies in Preparation for Human Exploration of Mars
Snook, Kelly, NASA Ames Research Center, USA; Workshop on Science and the Human Exploration of Mars; 2001, pp. 119-124; In English; See also 20010056494; No Copyright; Avail: CASI; A02, Hardcopy; A03, Microfiche

This paper presents the human exploration of Mars in viewgraph form.
CASI
Mars (Planet); Manned Mars Missions

20010056505 NASA Johnson Space Center, Houston, TX USA
Linking Human and Robotic Missions: Early Leveraging of the Code S Missions
Cooke, Doug, NASA Johnson Space Center, USA; Workshop on Science and the Human Exploration of Mars; 2001, pp. 125-139; In English; See also 20010056494; No Copyright; Avail: CASI; A03, Hardcopy; A03, Microfiche

A major long term NASA objective is to enable human exploration beyond low Earth orbit. This will take a strange approach, with a concentration on new, enabling technologies and capabilities. Mars robotic missions are logical and necessary steps in the progression toward eventual human missions.
Derived from text
Mars Missions; Robotics; Mars (Planet)

20010056506 NASA Johnson Space Center, Houston, TX USA
Mars Field Geology, Biology and Paleontology Workshop: Consensus, Recommendations and Progress
Dickerson, Patricia Wood, NASA Johnson Space Center, USA; Workshop on Science and the Human Exploration of Mars; 2001, pp. 140-146; In English; See also 20010056494; No Copyright; Avail: CASI; A02, Hardcopy; A03, Microfiche

The contents include: 1) Field Exploration Strategy; 2) Analytical Capabilities and Instruments; 3) Crew Skills and Training; and 4) Earth-Mars Communications. This paper is in viewgraph form.
CASI
Paleontology; Planetary Geology; Mars Surface

20010056507 Texas Univ., TX USA
Mars and Men
Muehlberger, W., Texas Univ., USA; Workshop on Science and the Human Exploration of Mars; 2001, pp. 147-149; In English; See also 20010056494; No Copyright; Avail: CASI; A01, Hardcopy; A03, Microfiche

Wherever mankind travels in space, people will always be preceded by unmanned probes that will provide the first bit of information. But there comes a time when we've learned all we can by unmanned vehicles. Man comes on the scene and makes the decisions about what is most valuable to us here, and that makes space into a new laboratory. Photography plays a vital role in all that John Glenn, in 'The View from Space'. Why do you take a photograph? We took a lot of documentation pictures because we were supposed to. But a lot of photographs were taken on instinct things you can't predict you're going to see or that are going to impress you. You say, 'Now I've got to take a picture of that" or "Look at the way that is positioned' or' Look at the way the sun is shining on that." Those 'stand-back' pictures were taken with aesthetics in mind, to capture and document the venture itself." Eugene Cernan in 'The View from Space'. The Apollo mode for a Science Support Room in Mission Control will not work for Mars. The time delay makes it nearly useless. Our team was available for instantaneous reaction and assistance to the crew on EVA. Therefore the Science Support Team has to be on Mars! The crew that went out the day before will do the supporting. They will hand off to each other for the next EVA. They will send a daily report back to Earth as to what was accomplished, problems that need resolution, supporting video, data, etc. etc. In Apollo, that was the role of my "Tiger Team," who sat in Gene Krantz' office watching and listening but having no role for directly helping the Back Room. They wrote a summary of the EVA, what was accomplished, what got omitted that was important to insert into the next EVA. It was distributed throughout Mission Control-especially to the Big Brass, Flight Director, and the CapCom.
Derived from text
Human Beings; Mars (Planet); Mars Exploration

20010056508 Los Alamos National Lab., NM USA

Human Role in Mars Drilling

Blacic, Jim, Los Alamos National Lab., USA; Dreesen, Don, Los Alamos National Lab., USA; Mockler, Ted, Los Alamos National Lab., USA; Workshop on Science and the Human Exploration of Mars; 2001, pp. 150-153; In English; See also 20010056494; No Copyright; Avail: CASI; A01, Hardcopy; A03, Microfiche

The role that humans play in Mars drilling is presented.

CASI

Drilling; Mars (Planet); Human Beings

20010056509 Notre Dame Univ., Dept. of Civil Engineering and Geological Sciences, IN USA

Geological Investigations of Mars: The Human Factor

Neal, Clive R., Notre Dame Univ., USA; Workshop on Science and the Human Exploration of Mars; 2001, pp. 154-155; In English; See also 20010056494; No Copyright; Avail: CASI; A01, Hardcopy; A03, Microfiche

Humans make better geologists than robots, and putting astronauts on the surface of Mars will greatly enhance scientific exploration and increase the chances for key scientific discoveries. Humans can recognize interesting samples and, importantly, place those samples in the overall geological context of the particular landing site. These attributes were amply demonstrated during the Apollo program, as for example when Jack Schmitt accidentally slipped and discovered the ”orange soil” (glass beads) at the Apollo 17 site. These samples remain some of the most important collected during the Apollo program and are still being analyzed by scientists worldwide. Because the Apollo missions were each of limited duration, no instruments were carried along for actual analysis of rock samples prior to returning them to Earth. However, human expeditions to Mars will likely involve extended stays (months). Assuming a limited capacity for returning geological samples, it will be highly advantageous to carry some rudimentary kinds of analytical equipment to the Martian surface in order to ensure that the most significant geological samples are collected and returned to Earth. This paper discusses some of the most useful and practical types of analytical equipment that might be taken along in order to characterize geological samples on the surface of Mars. Some useful tools actually can be carried by astronauts into ”the field” as opposed to remaining on the spacecraft lander. These portable instruments are mainly the simplest yet most important instruments. There is no substitute for a human eye coupled with a well-trained mind, and what the eye can see will be greatly enhanced by having a geological hammer (to expose fresh rock surfaces) and some kind of helmet compatible magnifier for first-order rock and mineral characterization.

Author

Mars Surface; Planetary Geology; Petrography

20010056510 NASA Ames Research Center, Moffett Field, CA USA

Astrobiology Sample Analysis as a Design Driver

Cohen, Marc M., NASA Ames Research Center, USA; Workshop on Science and the Human Exploration of Mars; 2001, pp. 156-176; In English; See also 20010056494; No Copyright; Avail: CASI; A03, Hardcopy; A03, Microfiche

This effort supports the Astrobiology Objective 8 the Search for LIFE ON MARS PAST AND PRESENT -(Astrobiology Program Office, 1998, p.7). The essential trade analysis is between returning very small samples to the Earth while protecting them versus in situ analysis on Mars. Developing these explicit parameters encompasses design, instrumentation, system integration, human factors and surface operations for both alternatives. This allocation of capability approach incorporates a ”humans and machines in the loop” model that recognizes that every exploration system involves both humans and automated systems. The question is where in the loop they occur whether on Earth, in the Mars Base, in the rover or creeping over the Mars surface.

Derived from text

Exobiology; Mars (Planet)

20010056512 Hawaii Univ., Hawaii Inst. of Geophysics and Planetology, Honolulu, HI USA

Human Exploration for Resources on Mars

Taylor, Jeff, Hawaii Univ., USA; Workshop on Science and the Human Exploration of Mars; 2001, pp. 184-186; In English; See also 20010056494; No Copyright; Avail: CASI; A01, Hardcopy; A03, Microfiche

Resources on Mars are presented.

CASI

Resources; Mars (Planet)

20010056741 Search for Extraterrestrial Intelligence Inst., Mountain View, CA USA

Mars Sample Return and Planetary Protection in a Public Context

Race, Margaret S., Search for Extraterrestrial Intelligence Inst., USA; Advances in Space Research; 1998; ISSN 0273-1177; Volume 22, No. 3, pp. 391-399; In English; Copyright; Avail: Issuing Activity

In order to minimize problems and prepare for possible challenges to Mars sample return missions, it is important to recognize the complexity of planetary protection requirements and integrate them early in the planning process together with economic, technical, scientific and other considerations. Of special concern are two particular non-scientific problem areas: (1) legal ambiguities and requirements, and (2) risk perceptions and attitudes about sample return, both of which have the potential to impact mission success in unpredictable ways. A cursory review of relevant laws and legal issues combined with research findings about risk perceptions, have highlighted these problem areas in the decision making process ahead. It is likely that challenges or opposition will center around pre-launch decision making and subsequent Earth based sample handling rather than space operations per se. Ultimately, overall mission success may depend on understanding how the technical and scientific implications of planetary protection interact with legitimate legal and societal issues related to activities both in space and on Earth.

Author

Protection; Mars Sample Return Missions; Mission Planning; Planetary Quarantine

20010056901 Search for Extraterrestrial Intelligence Inst., USA

Detection of Soluble and Fixed NH4+ in Clay Minerals by DTA and IR Reflectance Spectroscopy : A Potential Tool for Planetary Surface Exploration

Janice, Bishop, Search for Extraterrestrial Intelligence Inst., USA; Banin, A., NASA Ames Research Center, USA; Mancinelli, R. L., NASA Ames Research Center, USA; Klovstad, M. R., NASA Ames Research Center, USA; [2001]; 1p; In English

Contract(s)/Grant(s): NCC2-1100; No Copyright; Avail: Issuing Activity; Abstract Only

Nitrogen is an essential element for life. It is the only element among the six major biogenic elements, C, O, S, O, P, H, whose presence in the Martian soil has not been positively and directly established. We describe here a study assessing the ability to detect NH4 in soils by two methods: differential thermal analysis (DTA) and infrared (IR) reflectance spectroscopy. Four standard clay minerals (kaolinite, montmorillonite, illite and attapulgite) and an altered tephra sample from Mauna Kea were treated with NH4 in this study. Samples of the NH4-treated and leached clays were analyzed by DTA and infrared (IR) reflectance spectroscopy to quantify the delectability of soluble and sorbed/fixed NH4. An exotherm at 270-280 C was clearly detected in the DTA curves of NH4-treated (non-leached) samples. This feature is assigned to the thermal decomposition reaction of NH4. Spectral bands observed at 1.56, 2.05, 2.12, 3.06, 3.3, 3.5, 5.7 and 7.0 microns in the reflectance spectra of NH4-treated and leached samples are assigned to the sorbed/fixed ammonium in the clays. The montmorillonite has shown the most intense absorbance due to fixed ammonium among the leached samples in this study, as a result of its high cation sorption capacity. It is concluded that the presence of sorbed or fixed NH4 in clays may be detected by infrared (IR) reflectance or emission spectroscopy. Distinction between soluble and sorbed NH4 may be achieved through the presence or absence of several spectral features assigned to the sorbed NH4 moietyi and, specifically, by use of the 4.2 micrometer feature assigned to solution NH4. Thermal analyses furnish supporting evidence of ammonia in our study through detection of N released at temperatures of 270-330 C. Based on these results it is estimated that IR spectra measured from a rover should be able to detect ammonia if present above 20 mg NH4/g sample in the surface layers. Orbital IR spectra and thermal analyses measured on a rover may be able to detect ammonia in soils as well but at higher abundances. The spectral features at 3.06 and 7.0 microns due to bound NH4 in clays and altered Hawaiian tephra appear to be the most promising for detection by orbital spectrometers. If N species are present on Mars the sedimentary deposits may be the best regions to look for them.

Author

Nitrogen; Planetary Surfaces; Infrared Radiation; Clays; Mars Surface; Soils; Ammonium Compounds; Emission Spectra

20010056936 Search for Extraterrestrial Intelligence Inst., Mountain View, CA USA

Integrating Public Perspectives in Sample Return Planning

Race, Margaret S., Search for Extraterrestrial Intelligence Inst., USA; MacGregor, G., Decision Research Corp., USA; Advances in Space Research; [2000]; 9p; In English

Contract(s)/Grant(s): NAG2-986; RTOP 986-97-01; Copyright; Avail: Issuing Activity

Planning for extraterrestrial sample returns, whether from Mars or other solar system bodies, must be done in a way that integrates planetary protection concerns with the usual mission technical and scientific considerations. Understanding and addressing legitimate societal concerns about the possible risks of sample return will be a critical part of the public decision making process ahead. This paper presents the results of two studies, one with lay audiences, the other with expert microbiologists, designed to gather information, on attitudes and concerns about sample return risks and planetary protection. Focus group

interviews with lay subjects, using generic information about Mars sample return and a preliminary environmental impact assessment, were designed to obtain an indication of how the factual content is perceived and understood by the public. A research survey of microbiologists gathered information on experts' views and attitudes about sample return, risk management approaches and space exploration risks. These findings, combined with earlier research results on risk perception, will be useful in identifying levels of concern and potential conflicts in understanding between experts and the public about sample return risks. The information will be helpful in guiding development of the environmental impact statement and also has applicability to proposals for sample return from other solar system bodies where scientific uncertainty about extraterrestrial life may persist at the time of mission planning.
Author
Mars Sample Return Missions; Surveys; Risk; Public Relations; Protection

20010057032 Search for Extraterrestrial Intelligence Inst., Mountain View, CA USA
Planning Considerations for Mars Sample Return Containment ***Final Report***
Race, Margaret S., Search for Extraterrestrial Intelligence Inst., USA; Allton, Judith H., Lockheed Martin Space Operations, USA; Allen, Carlton C., Lockheed Martin Space Operations, USA; Richmond, Jonathan Y., Centers for Disease Control and Prevention, USA; Journal of the American Biological Safety Association; 1999; Volume 4, No. 2, pp. 53-59; In English
Contract(s)/Grant(s): NAG2-986; Copyright; Avail: Issuing Activity

With a Mars sample return mission planned for launch as early as 2005, serious discussions have begun to identify practical, effective approaches for containing extraterrestrial rocks, soil, and atmospheric samples for return to Earth. In addition to satisfying planetary protection and biological safety requirements, containment designs must also meet planetary science and spaceflight engineering needs. to be effective, an integrated containment system must consider both outbound and inbound spaceflights, mobile and stationary containment, and operations on Earth. Important planning considerations include pre-launch preparations, the configuration and sealing of the sample return canister, Earth-return and recovery procedures, contingency planning, laboratory design, biosafety cabinets, sterilization methods, and alternative operational and facilities approaches. Solving the challenges of containment for extraterrestrial samples will be critical to mission success, not only for samples from Mars, but ultimately for sample returns from other bodies of biological interest within the solar system as well.
Author
Containment; Samples; Protection; Mars Sample Return Missions

20010057230 Vanderbilt Univ., Dept. of Chemical Engineering, Nashville, TN USA
Recovery of Minerals in Martian Soils Via Supercritical Fluid Extraction
Debelak, Kenneth A., Vanderbilt Univ., USA; Roth, John A., Vanderbilt Univ., USA; Microgravity Materials Science Conference 2000; March 2001; Volume 1, pp. 164-169; In English; See also 20010057199; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A02, Hardcopy

We are investigating the use of supercritical fluids to extract mineral and/or carbonaceous material from Martian surface soils and its igneous crust. Two candidate supercritical fluids are carbon dioxide and water. The Martian atmosphere is composed mostly of carbon dioxide (approx. 95.3%) and could therefore provide an in-situ source of carbon dioxide. Water, although present in the Martian atmosphere at only approx. 0.03%, is also a candidate supercritical solvent. Previous work done with supercritical fluids has focused primarily on their solvating properties with organic compounds. Interestingly, the first work reported by Hannay and Hogarth at a meeting of the Royal Society of London in 1879 observed that increasing or decreasing the pressure caused several inorganic salts e.g., cobalt chloride, potassium iodide, and potassium bromide, to dissolve or precipitate in supercritical ethanol. In high-pressure boilers, silica, present in most boiler feed waters, is dissolved in supercritical steam and transported as dissolved silica to the turbine blades. As the pressure is reduced the silica precipitates onto the turbine blades eventually requiring the shutdown of the generator. In supercritical water oxidation processes for waste treatment, dissolved salts present a similar problem. The solubility of silicon dioxide (SiO2) in supercritical water is shown. The solubility curve has a shape characteristic of supercritical systems. At a high pressure (greater than 1750 atmospheres) increasing the temperature results in an increase in solubility of silica, while at low pressures, less than 400 atm., the solubility decreases as temperature increases. There are only a few studies in the literature where supercritical fluids are used in extractive metallurgy. Bolt modified the Mond process in which supercritical carbon monoxide was used to produce nickel carbonyl (Ni(CO)4). Tolley and Tester studied the solubility of titanium tetrachloride (TiCl4) in supercritical CO2. They reported complete miscibility of TiCl4 with supercritical CO2 (infinite solubility). At 1500 psig, TiCl4 and CO2 form a single liquid phase below 50 C. Tolley et al. also reported on the solubility and thermodynamics of tin tetrachloride in supercritical CO2. Some of their data for TiC14 are shown. Three criteria have been suggested to predict which materials are suitable for supercritical extraction: 1) Hydrocarbons or lipophilic compounds of low

molecular weight and polarity are easily extracted with supercritical CO2. 2) Compounds with polar groups are not easily extracted with supercritical CO2. 3) Separation of mixtures is facilitated if components differing mass, vapor pressure, or polarity. Author

Mars Surface; Supercritical Fluids; Extraction; Precipitates; Carbon Dioxide; Carbonyl Compounds; Tetrachlorides

20010057262 Stanford Univ., Stanford, CA USA

Solid State Electrochemical Oxygen Conversion for Martian and Lunar Environments

Alemozafar, Ali Reza, Stanford Univ., USA; Guer, Turgut M., Stanford Univ., USA; Homsy, George M., Stanford Univ., USA; Microgravity Materials Science Conference 2000; March 2001; Volume 2, pp. 310-315; In English; See also 20010057256; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A02, Hardcopy

This work involves an innovative solid state electrochemical approach to address the need for on-site generation and recovery of oxygen for resource utilization and life-support systems for Martian and Lunar landing missions, and is concerned with the investigation of heterogeneous kinetics, materials and fluid dynamic issues presented by this electrochemical system in achieving this goal.

Author

Electrochemistry; Oxygen Supply Equipment; Extraterrestrial Resources; Life Support Systems

20010057306 Orbital Technologies Corp., Madison, WI USA

Carbon-Based Reduction of Lunar Regolith (CRLR)

Rice, Eric E., Orbital Technologies Corp., USA; Gustafson, Robert J., Orbital Technologies Corp., USA; Jordan, J., Orbital Technologies Corp., USA; Microgravity Materials Science Conference 2000; March 2001; Volume 3, pp. 499-504; In English; See also 20010057302; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A02, Hardcopy

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 a direct heating source, achieving high oxygen yield and high carbon (or hydrogen, depending on the reducing source) recovery. The direct heating approach uses the lunar regolith as its own insulative container. This approach allows extremely high processing temperatures (>2000 C) while eliminating 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 intends to demonstrate new techniques for achieving high oxygen yield and high carbon or hydrogen recovery. This will include developing integrated designs for both a production plant and a possible flight experiment on a NASA reduced-gravity aircraft.

Author

Lunar Soil; Liquid Oxygen; Metals; Microgravity; Reduction (Chemistry); Carbon; Gas Heating; Spaceborne Experiments; Temperature Profiles

20010057312 Massachusetts Inst. of Tech., Dept. of Materials Science and Engineering, Cambridge, MA USA

From Oxygen Generation to Metals Production: In Situ Resource Utilization by Molten Oxide Electrolysis

Sadoway, Donald R., Massachusetts Inst. of Tech., USA; Microgravity Materials Science Conference 2000; March 2001; Volume 3, pp. 525-530; In English; See also 20010057302; CD-ROM contains the entire Conference Proceedings presented in PDF format; No Copyright; Avail: CASI; A02, Hardcopy

The proposed work is in the area of Extraterrestrial Processes and Technology Development, specifically In Situ Resource Utilization (ISRU), and seeks to explore the use of molten oxide electrolysis for the generation of oxygen and the production of metals from natural resources found on the Moon/Mars. For the exploration of other bodies in the solar system, electrochemical processing is arguably the most versatile technology for conversion of local resources into usable commodities: by electrolysis one can produce (1) breathable oxygen, (2) silicon for the fabrication of solar cells, (3) various reactive metals for use as electrodes in advanced storage batteries, and (4) structural metals such as steel and aluminum. to date there has been no sustained effort to develop a process, in part due to the inadequacy of the database. The present study will identify chemistries capable of sustaining molten oxide electrolysis in the cited applications and will examine the behavior of laboratory-scale cells designed to generate

oxygen and produce metal. The basic research will include the study of the underlying high-temperature physical chemistry of oxide melts representative of lunar regolith and of Martian soil. to move beyond empirical approaches to process development, the thermodynamic and transport properties of oxide melts will be studied to help set the limits of composition and temperature for the processing trials that will follow. Process efficiency will be investigated in laboratory-scale electrolysis cells. For optimization, the kinetics of the relevant processes at the cathode and the anode will be studied by a.c. voltammetry and electrochemical impedance spectroscopy. The goal of this investigation is to deliver a working prototype cell that can use lunar regolith and Martian soil to produce breathable oxygen along with metal by-product. Additionally, the results of this work can be generalized to permit adaptation to accommodate different feedstock chemistries, such as those that will be encountered on other bodies in the solar system. The expected results of the proposed research are: (1) the identification of appropriate electrolyte chemistries; (2) the selection of candidate anode and cathode materials compatible with electrolytes named above; and (3) performance data from laboratory-scale cells producing oxygen and metal. This information will enable assessment of the technical viability of molten oxide electrolysis for in situ resource utilization on the Moon and Mars. In parallel, there may be commercial applications here on earth, specifically, new ”green” technologies for extraction of metals and for treatment of hazardous waste, e.g., fixing heavy metals.
Author
Oxygen Production; Metals; Physical Chemistry; Electrolysis; Fabrication; Silicon; Electrochemical Synthesis; Space Processing; Soils

20010057799 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA USA
Hot Spots on Io: Initial Results From Galileo’s Near Infrared Mapping Spectrometer
Lopes-Gautier, Rosaly, Jet Propulsion Lab., California Inst. of Tech., USA; Davies, A. G., Jet Propulsion Lab., California Inst. of Tech., USA; Carlson, R., Jet Propulsion Lab., California Inst. of Tech., USA; Smythe, W., Jet Propulsion Lab., California Inst. of Tech., USA; Kamp, L., Jet Propulsion Lab., California Inst. of Tech., USA; Soderblom, L., Geological Survey, USA; Leader, F. E., California Univ., USA; Mehlman, R., California Univ., USA; Geophysical Research Letters; Oct. 15, 1997; ISSN 0094-8534; Volume 24, No. 20, pp. 2439-2442; In English; Original contains color illustrations
Report No.(s): Paper-97GL02662; Copyright; Avail: Issuing Activity

The Near-Infrared Mapping Spectrometer on Galileo has monitored the volcanic activity on Io since June 28, 1996. This paper presents preliminary analysis of NIMS thermal data for the first four orbits of the Galileo mission. NIMS has detected 18 new hot spots and 12 others which were previously known to be active. The distribution of the hot spots on Io’s surface may not be random, as hot spots surround the two bright, SO2-rich regions of Bosphorus Regio and Colchis Regio. Most hot spots scan to be persistently active from orbit to orbit and 10 of those detected were active in 1979 during the Voyager encounters. We report the distribution of hot spot temperatures and find that they are consistent with silicate volcanism.
Author
Io; Hot Surfaces; Galileo Project; Infrared Imagery; Infrared Spectrometers; Near Infrared Radiation; Volcanology; Thermal Mapping; Volcanoes

20010058891 Search for Extraterrestrial Intelligence Inst., Mountain View, CA USA
Containment Design Concepts for Extraterrestrial Sample Materials, Chapter 11
Race, Margaret S., Search for Extraterrestrial Intelligence Inst., USA; Allton, Judith H., Lockheed Martin Engineering and Science Services, USA; Allen, Carlton C., Lockheed Martin Engineering and Science Services, USA; Richmond, Jonathan Y., Centers for Disease Control and Prevention, USA; Anthology of Biosafety: Perspectives on Laboratory Design; 1999; Volume 1, pp. 161-177; In English; Copyright; Avail: Issuing Activity

Containment needs for extraterrestrial sample materials present design challenges that go well beyond traditional biosafety considerations. In addition to ensuring biological safety and physical security of returned samples, containment designs must meet planetary science and spaceflight engineering needs as well. With a Mars sample return mission planned for around 2004, serious discussions have begun to identify practical, effective approaches to containment. to be effective, the ultimate design must include attention to a wide range of issues such as pre-launch preparations, the configuration and sealing of the sample return canister, Earth-return and recovery procedures, contingency planning, biosafety cabinets, and alternative operational approaches. Solving the challenges of containment for extraterrestrial samples will be critical to mission success-for protecting researchers and the biosphere; for maintaining the integrity of the samples for scientific study; and for fostering public confidence in our ability to return and handle materials from Mars and elsewhere in the solar system.
Author
Containment; Mars Sample Return Missions; Safety; Mission Planning; Protection

20010058915 NASA Ames Research Center, Moffett Field, CA USA

Planetary Protection, Sample Return Missions and Mars Exploration: History, Status, and Future Needs

DeVincenzi, Donald L., NASA Ames Research Center, USA; Race, Margaret S., Search for Extraterrestrial Intelligence Inst., USA; Klein, Harold P., Search for Extraterrestrial Intelligence Inst., USA; Journal of Geophysical Research; Nov. 25, 1998; ISSN 0148-0227; Volume 103, No. E12, pp. 28,577-28,585; In English

Report No.(s): Paper-98JE01600; Copyright; Avail: Issuing Activity

As the prospect grows for a Mars sample return mission early in the next millennium, it will be important to ensure that appropriate planetary protection (PP) controls are incorporated into the mission design and implementation from the start. The need for these PP controls is firmly based on scientific considerations and backed by a number of national and international agreements and guidelines aimed at preventing harmful cross contamination of planets and extraterrestrial bodies. The historical precedent for the use of PP measures on both unmanned and manned missions traces from post-Sputnik missions to the present, with periodic modifications as new information was obtained. In consideration of the anticipated attention to PP questions by both the scientific/technical community and the public, this paper presents a comprehensive review of the major issues and problems surrounding PP for a Mars Sample Return (MSR) mission, including an analysis of arguments that have been raised for and against the imposition of PP measures. Also discussed are the history and foundations for PP policies and requirements; important research areas needing attention prior to defining detailed PP requirements for a MSR mission; and legal and public awareness issues that must be considered with mission planning.

Author

Protection; Mission Planning; Mars Sample Return Missions; Histories

92
SOLAR PHYSICS

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

20010056295 NASA Goddard Space Flight Center, Greenbelt, MD USA

EUNIS: An Extreme-Ultraviolet Normal-Incidence Spectrometer

Thomas, Roger J., NASA Goddard Space Flight Center, USA; Davila, Joseph M., NASA Goddard Space Flight Center, USA; [2001]; 1p; In English; Solar Encounter: The First Solar Orbiter Workshop, 14-18 May 2001, Puerto de la Cruz, Spain; No Copyright; Avail: Issuing Activity; Abstract Only

GSFC is in the process of assembling an Extreme-Ultraviolet Normal-Incidence Spectrometer called EUNIS, to be flown as a sounding rocket payload. This instrument builds on the many technical innovations pioneered by our highly successful SERTS experiment over its past ten flights. The new design will have somewhat improved spatial and spectral resolutions, as well as 100 times greater sensitivity, permitting EUV spectroscopy with a temporal resolution near 1-second for the first time ever. to achieve such high time cadence, a novel Active-Pixel-Sensor detector is being developed as a key component of our design. The high sensitivity of EUNIS will allow entirely new studies of transient coronal phenomena, such as the rapid loop dynamics seen by TRACE, and searches for non-thermal motions indicative of magnetic reconnection or wave heating. The increased sensitivity will also permit useful EUV spectra at heights of 2-3-R$ \odot$ above the limb, where the transition between the static corona and the solar wind might occur. In addition, the new design features two independent optical systems, more than doubling the spectral bandwidth covered on each flight. Its 300-370\AA\ bandpass includes He-II 304\AA\ and strong lines from Fe-XI-XVI, extending the current SERTS range of 300-355\AA\ to further improve our ongoing series of calibration under-flights for SOHO/CDS and EIT. The second bandpass of 170-230\AA\ has a sequence of very strong Fe-IX-XIV lines, and will allow under-flight support for two more channels on SOHO/EIT, two channels on TRACE, one on Solar-B/EIS, and all four channels on the STEREO/EUVI instrument. First flight of the new EUNIS payload is scheduled for 2002 October.

Author

Extreme Ultraviolet Radiation; Spectrometers; Sounding Rockets; Magnetic Field Reconnection; Temporal Resolution

20010056299 Solar Physics Research Corp., Tucson, AZ USA

Helioseismic Holography and a Study of the Process of Magnetic Flux Disappearance in Canceling Bipoles ***Final Report, 2 Dec. 1997 - 1 Aug. 1999***

Lindsey, Charles, Solar Physics Research Corp., USA; Harvey, Karen L., Solar Physics Research Corp., USA; Braun, D., Solar Physics Research Corp., USA; Jones, H. P., Solar Physics Research Corp., USA; Penn, M., Solar Physics Research Corp., USA; Hassler, D., Solar Physics Research Corp., USA; Aug. 01, 2001; 29p; In English

Contract(s)/Grant(s): NASW-97029

Report No.(s): SOPC-nasa-97029.f7; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Project 1: We have developed and applied a technique of helioseismic holography along the lines of originally set out in our proposal. The result of the application of this diagnostic technique to solar activity and the quiet Sun has produced a number of important discoveries: (1) acoustic moats surrounding sunspots; (2) acoustic glories surround large active regions; (3) acoustic condensations beneath active regions; and (4) temporally-resolve acoustic images of a solar flare. These results have been published in a series of papers in the Astrophysical Journal. We think that helioseismic holography is now established as the most powerful and discriminating diagnostic in local helioseismology. Project 2: We conducted a collaborative observational program to define the physical character and magnetic geometry of canceling magnetic bipoles aimed at determining if the cancellation process is the result of submergence of magnetic fields. This assessment is based on ground-based observations combining photospheric and chromospheric magnetograms from NSO/KP, BBSO, and SOHO-MDI, and EUV and X-ray images from SOHO EIT/CDS, Yohkoh/SXT, and TRACE. Our study involves the analysis of data taken during three observing campaigns to define the height structure of canceling bipoles inferred from magnetic field and intensity images, and how this varies with time. We find that some canceling bipoles can be explained by the submerge of their magnetic flux. A paper on the results of this analysis will be presented at an upcoming scientific meeting and be written up for publication.

Author

Helioseismology; Holography; Acoustics; Solar Magnetic Field; Bipolarity

20010057182 NASA Ames Research Center, Moffett Field, CA USA

The A6Sigma+ - X6Sigma+ Transition of CrH, Einstein Coefficients and an Improved Description of the A State

Bauschlicher, Charles W., Jr., NASA Ames Research Center, USA; Ram, R. S., Arizona Univ., USA; Bernath, Peter F., Waterloo Univ., Canada; Parsons, C. G., Dayton Univ., USA; Galehouse, D., Dayton Univ., USA; [2001]; 1p; In English

Contract(s)/Grant(s): RTOP 519-40-12; No Copyright; Avail: Issuing Activity; Abstract Only

The spectrum of CrH has been reinvestigated in the 9000-15000/cm region using the Fourier transform spectrometer of the National Solar Observatory. The 1-0 and 1-1 bands of the A6Sigma+ - X6Sigma+ transition have been measured and improved spectroscopic constants have been determined. A value for the 2-0 band origin has been obtained from the band head using estimated spectroscopic constants. These data provide a set of much improved equilibrium vibrational and rotational constants for the A6Sigma+ state. An accurate description of the A-X transition has been obtained using a multi-reference configuration interaction approach. The inclusion of both scalar relativity and Cr 3s3p correlation are required to obtain a good description of both states. The ab initio computed Einstein coefficients and radiative lifetimes are reported.

Author

Coefficients; Configuration Interaction; Absorption Spectra; Spectroscopy

93
SPACE RADIATION

Includes cosmic radiation; and inner and outer Earth radiation belts. For biological effects of radiation on plants and animals see 52 Aerospace Medicine. For theory see 73 Nuclear Physics.

20010054789 Boston Univ., Dept. of Astronomy, Boston, MA USA

Frequency Stratification of the Nonthermal Emission in Blazars ***Final Report, 1 Mar. 1997 - 28 Feb. 2001***

Marscher, Alan P., Boston Univ., USA; [2001]; 4p; In English

Contract(s)/Grant(s): NAG5-3839; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

Research supported by this grant involved theoretical investigations of the multifrequency nonthermal emission from the relativistic jets in blazars, which are quasars and related objects with highly variable brightness. In the initial stage of the project, one-dimensional, conical (i.e., spherical symmetry between the jet axis and surface is assumed) jet models were used to explain the multi-waveband spectra and variability of blazars. The results were applied to two flares observed in the object PKS 2155-304, leading to the conclusion that the distinct differences in the observed characteristics of the two flares can be explained with the same jet model if two different physical parameters (the magnetic field in the first flare and the efficiency of acceleration of electrons to high energies in the second) varied.

Derived from text

Nonthermal Radiation; Blazars; Plasma Jets; Variability

20010055432 Columbia Univ., Columbia Astrophysics Lab., New York, NY USA

Search for the Identification of 3EG J1835+5918: Evidence for a New Type of High-Energy Gamma-Ray Source?

Mirabal, N., Columbia Univ., USA; Halpern, Jules P., Columbia Univ., USA; Eracleous, M., Columbia Univ., USA; Becker, R. H., Columbia Univ., USA; The New X-Ray/Gamma-Ray Pulsars; May 2001, pp. 12; Repr. from Bulletin of the American Astronomical Society, v. 31, 1999 p 1410; In English

Contract(s)/Grant(s): NAG5-3229; Copyright; Avail: Issuing Activity; Abstract Only

Most of the EGRET high-energy gamma-ray sources remain unidentified. It is highly likely that many of these are fainter blazars or pulsars, but there may also be new types of sources to be discovered. We have focussed our search for novel gamma-ray sources on 3EG 1835+5918, which is the brightest and most accurately positioned of the unidentified EGRET sources at high Galactic latitude (l, b = 89 deg, 25 deg). In this talk, we will summarize the results of X-ray, radio, and optical surveys of this location. In particular, we have made complete optical identifications of all of the ROSAT and ASCA sources in this region to a flux limit of approximately 1 x 10(exp -13) ergs/sq cm s. All of the X-ray sources within the EGRET error circle are radio-quiet quasars or coronally emitting stars. Previous radio pulsar searches have been unsuccessful. We set an upper limit of 3.8 mJy (at 1.4 GHz) on any possible radio counterpart to 3EG 1835+5918. We also find several quasars and white dwarfs using optical color selection, and we have monitored the entire field for variable optical objects on short and long time scales. Since no blazar-like or pulsar-like candidate has been found as a result of these searches, we assert that 3EG 1835+5918 must be lacking in one or more of the physically essential attributes of those classes of gamma-ray emitters. In particular, its radio flux is at least two orders of magnitude fainter than any of the securely identified EGRET blazars, and its soft X-ray flux is at least 30 times fainter than that of Geminga and other EGRET pulsars. If it is an AGN it lacks the beamed radio emission of blazars. If it is an isolated neutron star, it lacks both the thermal X-rays from a cooling surface and the magnetospheric non-thermal X-ray emission that is characteristic of all EGRET pulsars. As such, it is more problematic physically than Geminga, which is an ordinary pulsar that only lacks radio emission. As a pulsar, 3EG 1835+5918 would have to be either older or more distant than Geminga, and probably an even more efficient gamma-ray engine.

Author

Gamma Rays; X Ray Sources; Blazars; Pulsars; Optical Control; Radio Emission; Neutron Stars; Emitters

20010055638 Columbia Univ., Columbia Astrophysics Lab., New York, NY USA

Search for the Identification of 3EG J1835+5918: Evidence for a New Type of High-Energy Gamma-Ray Source

Mirabal, N., Columbia Univ., USA; Halpern, Jules P., Columbia Univ., USA; Eracleous, M., Columbia Univ., USA; Becker, R. H., Columbia Univ., USA; The New X-Ray/Gamma-Ray Pulsars; May 2001, pp. 12-13; Repr. from The Astrophysical Journal, v. 541, 2001 p 180; In English

Contract(s)/Grant(s): NAG5-3229; Copyright; Avail: Issuing Activity; Abstract Only

The EGRET source 3EG J1835+5918 is the brightest and most accurately positioned of the as-yet unidentified high-energy gamma-ray sources at high Galactic latitude (l, b = 89 deg, 25 deg). We present a multiwavelength study of the region around it, including X-ray, radio, and optical imaging surveys, as well as optical spectroscopic classification of most of the active objects in this area. Identifications are made of all but one of the ROSAT and ASCA sources in this region to a flux limit of approximately 5 x 10(exp -14) erg/sq cm s, which is 10(exp -4) of the gamma-ray flux. The identified X-ray sources in or near the EGRET error ellipse are radio-quiet QSOs, a galaxy cluster, and coronal emitting stars. We also find eight quasars using purely optical color selection, and we have monitored the entire field for variable optical objects on short and long time scales without any notable discoveries. The radio sources inside the error ellipse are all fainter than 4 mJy at 1.4 GHz. There are no flat-spectrum radio sources in the vicinity; the brightest neighboring radio sources are steep-spectrum radio galaxies or quasars. Since no blazar-like or pulsar-like candidate has been found as a result of these searches, 3EG J1835+5918 must be lacking one or more of the physically essential attributes of these known classes of gamma-ray emitters. If it is an AGN it lacks the beamed emission radio of blazars by at least a factor of 100 relative to identified EGRET blazars. If it is an isolated neutron star, it lacks the steady thermal X-rays from a cooling surface and the magnetospheric non-thermal X-ray emission that is characteristic of all EGRET pulsars. If a pulsar, 3EG J1835+5918 must be either older or more distant than Geminga, and probably an even more efficient or beamed gamma-ray engine. One intermittent ROSA T source falls on a blank optical field to a limit of B greater than 23.4, V greater than 23.3, and R greater than 22.5. In view of this conspicuous absence, RX J1836-2+5925 should be examined further as a candidate for identification with 3EG J1835+5918 and possibly the prototype of a new class of high-energy gamma-ray source.

Author

X Ray Sources; Wavelengths; Imaging Techniques; Radio Galaxies; Neutron Stars; Galactic Clusters; Light Emission

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Jets in Gamma-Ray Bursts

Sari, R., Columbia Univ., USA; Piran, T., Columbia Univ., USA; Halpern, Jules P., Columbia Univ., USA; The New X-Ray/Gamma-Ray Pulsars; May 2001, pp. 11; Repr. from The Astrophysical Journal Letters, v. 519, 1999 p L17; In English
Contract(s)/Grant(s): NAG5-3229; Copyright; Avail: Issuing Activity; Abstract Only

In the afterglows of several gamma-ray bursts (GRBs), rapid temporal decay, which is inconsistent with spherical (isotropic) blast-wave models, is observed. In particular, GRB 980519 had the most rapidly fading of the well-documented GRB afterglows, with t(sup -2.05 +/- 0.04) in optical as well as in X-rays. We show that such temporal decay is more consistent with the evolution of a jet after it slows down and spreads laterally, for which t(sup -P) decay is expected (where p is the index of the electron energy distribution). Such a beaming model would relax the energy requirements on some of the more extreme GRBs by a factor of several hundred. It is likely that a large fraction of the weak- (or no-) afterglow observations are also due to the common occurrence of beaming in GRBs and that their jets have already transitioned. to the spreading phase before the first afterglow observations were made. With this interpretation, a universal value of p approx. = 2.4 is consistent with all data.
Derived from text

Shock Waves; Detonation Waves; Afterglows; Gamma Ray Bursts

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Supernova 1998bw In ESO 184-G82

Kay, L. E., Columbia Univ., USA; Halpern, Jules P., Columbia Univ., USA; Leighly, K. M., Columbia Univ., USA; Heathcote, S., Cerro Tololo Inter-American Observatory, Chile; Magalhaes, A. M., Sao Paulo Univ., Brazil; The New X-Ray/Gamma-Ray Pulsars; May 2001, pp. 9; In English
Contract(s)/Grant(s): NAG5-3229; Copyright; Avail: Issuing Activity; Abstract Only

Over the wavelength range 390-750 nm, we measure intrinsic linear polarization of 0.53 +/- 0.08 percent at position angle 49 +/- 3 deg, after correcting for Galactic interstellar polarization using the star HD 184100, which has polarization of 0.75 +/- 0.01 percent at p.a. 176.5 +/- 2.5 deg. This measured interstellar polarization is consistent with the Galactic extinction in this direction, estimated to be E(B-V) = 0.059 from IRAS maps, or E(B-V) = 0.079 from 21-cm H I. Interstellar polarization in the host galaxy ESO 184-G82 is expected to be negligible based on the relative absence of Na I D absorption at z = 0.00841 +/- 0.00005, the redshift of the environment of the supernova from narrow H II region emission lines in its spectrum. Polarization appears highest in between emission features in the total flux spectrum, which strengthens the interpretation of the polarization as intrinsic to the supernova. This modest polarization is less than that of some type-II supernovae, but greater than that of type-Ia supernovae, which are generally unpolarized. This supports the interpretation of SN 1998bw, a peculiar type-Ic supernova, as a core-collapse event in which the observed polarization is due to moderate asymmetry in either the photosphere of the ejecta or an overlying scattering envelope. However, this result does not strongly constrain arguments about whether some supernovae emit gamma-ray bursts, since such emission may come from a mildly relativistic shock associated with the radio emission and above the optical photosphere, without any requirements on beaming or orientation." A. V. Filippenko, University of California at Berkeley, comments on the total flux spectrum obtained above: "The spectrum most closely resembles those of the peculiar SN 1997ef, but perhaps evolving more slowly. It is not typical of type-Ic supernovae; indeed, the spectrum does not match any of the known spectral classes, but perhaps 'peculiar type Ic' is the best choice at this time. The object appears to be starting a transition to the nebular phase, but identifications of the broad emission features are uncertain. The feature at 650 nm is probably [Fe III], as is the one at 455 nm (perhaps with some contribution from Mg I]). That at 590 nm may be a mixture of [Co III] and Na D. The strongest feature, at 545 nm, may consist of Fe, Co, and Ti lines."
Author

Supernovae; Linear Polarization; Emission Spectra; Electromagnetic Measurement; Gamma Rays

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X-Ray Emission from the Millisecond Pulsar J1012+5307

Halpern, Jules P., Columbia Univ., USA; Wang, F. Y.-H., Columbia Univ., USA; The New X-Ray/Gamma-Ray Pulsars; May 2001, pp. 6-7; Repr. from Bulletin of the American Astronomical Society, v. 20, 1997 p 1391; In English
Contract(s)/Grant(s): NAG5-3229; Copyright; Avail: Issuing Activity; Abstract Only

The recently discovered 5.3 ms pulsar J1012+5307 at a distance of 520 pc is in an area of the sky which is particularly deficient in absorbing gas. The column density along the line of sight is less than 7.5 x 10(exp 19)/sq cm, which facilitates soft X-ray observations. Halpern reported a possible ROSAT PSPC detection of the pulsar in a serendipitous, off-axis observation. We have now confirmed the X-ray emission of PSR J1012+5307 in a 23 ksec observation with the ROSAT HRI. A point source is detected within 3 sec. of the radio position. Its count rate of 1.6 +/- 0.3 x 10(exp -3)/s corresponds to an unabsorbed 0.1 - 2.4 keV flux of

6.4 x 10(exp -14) ergs/sq cm s, similar to that reported previously. This counts-to-flux conversion is valid for N(sub H) = 5 x 10(exp 19)/sq cm, and either a power-law spectrum of photon index 2.5 or a blackbody of kT = 0.1 keV. The implied X-ray luminosity of 2.0 x 10(exp 30) ergs/ s is 5 x 10(exp -4) of the pulsar's spin-down power E, and similar to that of the nearest millisecond pulsar J0437-4715, which is nearly a twin of J1012+5307 in P and E. We subjected the 37 photons (and 13 background counts) within the source region to a pulsar search, but no evidence for pulsation was found. The pulsar apparently emits over a large fraction of its rotation cycle, and the absence of sharp modulation can be taken as evidence for surface thermal emission, as favored for PSR J0437-4715, rather than magnetospheric X-ray emission which is apparent in the sharp pulses of the much more energetic millisecond pulsar B1821-24. A further test of of the interpretation will be made with a longer ROSAT observation, which will increase the number of photons collected by a factor of 5, and permit a more sensitive examination of the light curve for modulation due to emission from heated polar caps. If found, such modulation will be further evidence that surface reheating by the impact of particles accelerated along open field lines operates in these approx. 10(exp 9) yr old pulsars.
Author
X Rays; Thermal Emission; Pulsars; Polar Caps; Luminosity

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A Broad-Band X-Ray Study of the Geminga Pulsar
Halpern, Jules P., Columbia Univ., USA; Wang, F. Y.-H., Columbia Univ., USA; The New X-Ray/Gamma-Ray Pulsars; May 2001, pp. 5-6; Repr. from The Astrophysical Journal, v. 477, 1997 p 905; In English
Contract(s)/Grant(s): NAG5-3229; Copyright; Avail: Issuing Activity; Abstract Only

We present a comprehensive study of the Geminga pulsar at energies 0.1-10 keV using data from the ASCA, ROSAT, and EUVE satellites. The bulk of the soft X-ray flux can be parameterized as a blackbody of T = (5.6 +/- 0.6) x 10(exp 5) K, occupying a fraction 0. 10 - 0.64 of the surface area of the neutron star at the parallax distance of 160 pc. The ASCA detection of Geminga resolves the nature of the harder X-ray component previously discovered by ROSAT in favor of nonthermal emission, rather than thermal emission from a heated polar cap. The hard X-ray spectrum can be fitted by a power-law of energy index 1.0 +/- 0.5. The hard X-ray light curve has a strong main peak and a weak secondary peak; its total pulsed fraction is = 55%. Three ROSAT PSPC observations show significant variability of Geminga's light curve. In particular, a peculiar energy dependence of the modulation in the soft X-ray component, dubbed the "Geminga effect" in the original PSPC data, is not present in later observations. In addition, fine structure in the soft X-ray light curve, interpreted as eclipses due to cyclotron resonance scattering by a plasma screen on the closed magnetic field lines, almost disappeared in the most recent observations. All of the variable properties of Geminga can probably be associated with the nonthermal process that supplies e(sup +, sup -) pairs to its inner magnetosphere.
Author
Broadband; X Rays; Fine Structure; Inner Radiation Belt; Magnetic Fields; Neutron Stars; Polar Caps; Pulsars; Resonance Scattering; Spectra

20010055643 Columbia Univ., Columbia Astrophysics Lab., New York, NY USA
The Geminga Pulsar: Soft X-Ray Variability and an EUVE Observation
Halpern, Jules P., Columbia Univ., USA; Martin, Christopher, Columbia Univ., USA; Marshall, Herman L., Columbia Univ., USA; The New X-Ray/Gamma-Ray Pulsars; May 2001, pp. 5; Repr. from The Astrophysical Journal Letters, v. 473, 1996 p L37; In English
Contract(s)/Grant(s): NAG5-3229; Copyright; Avail: Issuing Activity; Abstract Only

We observed the Geminga pulsar with the EUVE satellite, detecting pulsed emission in the Deep Survey imager. Joint spectral fits of the EUVE flux with ROSAT PSPC data are consistent with thermal plus power-law models in which the thermal component makes the dominant contribution to the soft X-ray flux seen by EUVE and ROSAT. The data are consistent with blackbody emission of T = (4 - 6) x 10(exp 5) K over most of the surface of the star at the measured parallax distance of 160 pc. Although model atmospheres are more realistic, and can fit the data with effective temperatures a factor of 2 lower, current data would not discriminate between these and blackbody models. We also find evidence for variability of Geminga's soft X-ray pulse shape. Narrow dips in the light curve that were present in 1991 had largely disappeared in 1993/1994, causing the pulsed fraction to decline from 32% to 18%. If the dips are attributed to cyclotron resonance scattering by an e1 plasma on closed magnetic field lines, then the process that resupplies that plasma must be variable.
Author
Pulsars; X Rays; Atmospheric Models; Detection; Plasmas (Physics); Spectra

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Multiwavelength Examination of the COS B Field 2CG 075+00 Yields a Blazar Identification for 3EG J2016+3657

Mukherjee, R., Columbia Univ., USA; Gotthelf, E. V., Columbia Univ., USA; Halpern, Jules P., Columbia Univ., USA; Tavani, M., Columbia Univ., USA; The New X-Ray/Gamma-Ray Pulsars; May 2001, pp. 13; Repr. from The Astrophysical Journal, v. 542, 2000 p 740; In English

Contract(s)/Grant(s): NAG5-3229; Copyright; Avail: Issuing Activity; Abstract Only

We present a high-energy study of the intriguing COS B gamma-ray field, 2CG 075+00, in order to search for possible counterparts. New EGRET data show that the COS B emission probably corresponds to two localized gamma-ray sources, 3EG J2016+3657 and 3EG J2021+3716. Spectral fits to these EGRET sources, assuming a power-law model, yield photon indices of approx. 2 for each object. We examine archival ROSAT and ASCA X-ray data that overlap both EGRET error boxes and find several point sources in the region to a flux limit of approximately 6.5 x 10(exp -13) ergs/sq cm s. We conclude that the most probable candidate for 3EG J2016+3657 is the compact, variable, flat-spectrum radio and millimeter source B2013+370 (G74.87+1.22), which has blazar like properties. The other source, 3EG J2021+3716, remains unidentified.

Author

Wavelengths; Blazars; Gamma Rays; Spectra; Millimeter Waves

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Discovery of a Hand X-Ray Source, SAX J0635+0533, in the Error Box of the Gamma-Ray Source 2EG J0635+0521

Kaaret, P., Columbia Univ., USA; Piraino, S., Columbia Univ., USA; Halpern, Jules P., Columbia Univ., USA; Eracleous, M., Columbia Univ., USA; The New X-Ray/Gamma-Ray Pulsars; May 2001, pp. 11; Repr. from The Astrophysical Journal, v. 523, 1999 p 197; In English

Contract(s)/Grant(s): NAG5-3229; Copyright; Avail: Issuing Activity; Abstract Only

We have discovered an X-ray source, SAX J0635+0533, with a hard spectrum within the error box of the GeV gamma-ray source in Monoceros, 2EG J0635+0521. The unabsorbed flux from the source is 1.2 x 10(exp -11) ergs /sq cm s in the 2-10 keV band. The X-ray spectrum is consistent with a simple power-law model with absorption. The photon index is 1.50 +/- 0.08, and we detect emission out to 40 keV. Optical observations identify a counterpart with a V magnitude of 12.8. The counterpart has broad emission lines and the colors of an early B-type star. If the identification of the X-ray/optical source with the gamma-ray source is correct, then the source would be a gamma-ray-emitting X-ray binary.

Author

X Ray Sources; Gamma Rays; Emission Spectra; B Stars; Visual Observation

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The Rapidly Fading Afterglow of GRB 980519

Halpern, Jules P., Columbia Univ., USA; Kemp, J., Columbia Univ., USA; Piran, T., Columbia Univ., USA; Bershady, M. A., Columbia Univ., USA; The New X-Ray/Gamma-Ray Pulsars; May 2001, pp. 10-11; Repr. from The Astrophysical Journal Letters, v. 517, 1999 p L105; In English

Contract(s)/Grant(s): NAG5-3229; Copyright; Avail: Issuing Activity; Abstract Only

GRB 980519 had the most rapidly fading of the well-documented GRB afterglows, consistent with t(sup -2.05 +/- 0.04) in BVRI as well as in X-rays during the two days in which observations were made. We report VRI observations from the MDM 1.3m and WIYN 3.5m telescopes, and we synthesize an optical spectrum from all of the available photometry. The optical spectrum alone is well fitted by a power law of the form nu(sup - 1.20 +/- 0.25), with some of the uncertainty due to the significant Galactic reddening in this direction. The optical and X-ray spectra together are adequately fitted by a single power law nu(sup 1.05 +/- 0.10). This combination of steep temporal decay and flat broad-band spectrum places a severe strain on the simplest afterglow models involving spherical blast waves in a homogeneous medium. Instead, the rapid observed temporal decay is more consistent with 2 models of expansion into a medium of density n(r) proportional to r(sup -2), or with predictions of the evolution of a jet after it slows down and spreads laterally. The jet model would relax the energy requirements on some of the more extreme GRBs, of which GRB 980519 is likely to be an example because of its large gamma-ray fluence and faint host galaxy.

Author

Afterglows; X Rays; Stellar Spectra; Light (Visible Radiation); Gamma Rays

20010055647 Columbia Univ., Columbia Astrophysics Lab., New York, NY USA

Magnetospheric Geometry in PSR B1929+10 from Radio/X-Ray Alignment

Somer, A. L., Columbia Univ., USA; Backer, D. C., Columbia Univ., USA; Halpern, Jules P., Columbia Univ., USA; Wang, F. Y.-H., Columbia Univ., USA; The New X-Ray/Gamma-Ray Pulsars; May 2001, pp. 10; Repr. from Bulletin of the American

Astronautical Society, v. 30, 1998 p 921; In English
Contract(s)/Grant(s): NAG5-3229; Copyright; Avail: Issuing Activity; Abstract Only

We have conducted a study of two rotation- powered pulsars that emit at both radio and x-ray wavelengths, PSR B0531+21 and PSR B1929+10. Using absolute phase information, we have phase-aligned x-ray and radio profiles from these pulsars. Observations were done using the Green Bank 140ft telescope, and ASCA. The 0531+21 X-ray profile is sharp and lines up well with the radio profile confirming that the X-ray emission from this pulsar is magnetospheric in origin. The 1929+10 profile is approximately sinusoidal with the peak of the emission arriving 67+/-23 degrees after the maximum in the radio emission. The controversy to which the PSR B1929+10 result adds fuel, is whether this ”inter” -pulsar, is an ”aligned” or ”orthogonal” rotator -- describing the alignment of the magnetic axis to the rotation axis. Do the two peaks in the radio profile (the pulse and interpulse) come from a double crossing of a thin hollow cone nearly aligned with rotation axis, or alternatively do they come from from opposite poles of an ”orthogonal” rotator where the spin axis is perpendicular to the magnetic axis? The radio to X-ray alignment we find favors the former explanation: if the X-ray hot spot is the result of return currents to the surface from the outward current that generates radio emission, then in the ”double-crossing” model, the hot spot phase is expected to lie between the main pulse and interpulse as observed.
Author
Magnetospheres; Pulsars; X Rays; Geometry; Radio Emission

20010055648 Columbia Univ., Columbia Astrophysics Lab., New York, NY USA
The Optical Spectrum of the Geminga Pulsar
Martin, Christopher, Columbia Univ., USA; Halpern, Jules P., Columbia Univ., USA; Schiminovich, David, Columbia Univ., USA; The New X-Ray/Gamma-Ray Pulsars; May 2001, pp. 8; Repr. from The Astrophysical Journal Letters, v. 494, 1998 p L211; In English
Contract(s)/Grant(s): NAG5-3229; Copyright; Avail: Issuing Activity; Abstract Only

We obtained an optical spectrum of the isolated pulsar Geminga at the Keck Observatory. The optical object is at the limit of spectroscopic capability of any telescope, with a continuum flux that is approx. 0.5% of the dark sky on Mauna Kea. With particular attention paid to the dominant systematics of sky subtraction in our observing and analysis methods, we attained approx. 0.1% systematics in heavily binned spectra. The resulting spectrum spanning 3700 - 8000 A has a flat power-law shape f(sub nu) proportional to nu(exp -0.8) and a broad dip over 6300 - 6500 A. Thermal radiation cannot explain the optical spectrum of Geminga. The dominant component can be modeled as either electron synchrotron emission and ion (proton) cyclotron absorption, or ion cyclotron emission, the latter in a 10(exp 11) G magnetic field.
Author
Pulsars; Spectra; Cyclotron Radiation; Electron Emission; Light (Visible Radiation); Thermal Radiation; Light Emission

20010055649 Columbia Univ., Columbia Astrophysics Lab., New York, NY USA
ASCA Observations of PSR 1929+10 and PSR 0950+08
Wang, F. Y.-H., Columbia Univ., USA; Halpern, Jules P., Columbia Univ., USA; The New X-Ray/Gamma-Ray Pulsars; May 2001, pp. 7; Repr. from The Astrophysical Journal Letters, v. 482, 1997 p L159; In English
Contract(s)/Grant(s): NAG5-3229; Copyright; Avail: Issuing Activity; Abstract Only

The ASCA X-ray spectra of the old pulsars PSR 1929+10 and PSR 0950+08 are adequately fitted by simple blackbodies. Between 0.5 and 5.0 keV, PSR 1929+10 is best fitted with T = (5.14 +/- 0.53) x 10(exp 6) K and L = 1.54 x 10(exp 30) ergs/s; PSR 0950+08 has T = (5-70 +/- 0.63) x 10(exp 6) K and L = 4.67 x 10(exp 29) ergs/s. The inferred areas are 2 orders of magnitude smaller than canonical polar cap sizes. There is some evidence for a dearth of photons above 5 keV, which would disfavor alternative power-law models for the spectra. Pulsed emission is detected from PSR 1929+10 with 99.8% significance and pulsed fraction 0.35 +/- 0.18. Marginal evidence of pulsed X-ray emission from PSR 0950+08 is present with 99.0% significance and pulsed fraction 0.34+/- 0.18. Relativistic ray tracing shows that if the geometry deduced from the polarization of the radio pulse is adopted for the surface thermal emission, a central dipole cannot reproduce the large pulsed modulations observed unless the radius of the neutron star is as large as 18 km. A mechanism of polar cap heating by the impact of relativistic particles is suggested that can produce small areas with T approx. 5 x 10(exp 6) K on old, spun-down pulsars with weak magnetic fields (B approx. 3 x 10(exp 11) G).
Author
X Ray Spectra; Magnetic Fields; Pulsars; Thermal Emission

20010055650 Columbia Univ., Columbia Astrophysics Lab., New York, NY USA

Discovery of a Nonblazar Gamma-Ray Transient Source Near the Galactic Plane: GRO J1838-04

Tavani, M., Columbia Univ., USA; The New X-Ray/Gamma-Ray Pulsars; May 2001, pp. 6; Repr. from The Astrophysical Journal Letters, v. 479, 1997 p L109; In English

Contract(s)/Grant(s): NAG5-3229; Copyright; Avail: Issuing Activity; Abstract Only

We report the discovery of a remarkable gamma-ray transient source near the Galactic plane, GRO J1838-04. This source was serendipitously discovered by EGRET in 1995 June with a peak intensity of approx. (4 +/- 1) x 10(exp -6) photons/sq cm s (for photon energies larger than 100 MeV) and a 5.9 sigma significance. At that time, GRO J1838-04 was the second brightest gamma-ray source in the sky. A subsequent EGRET pointing in 1995 late September detected the source at a flux smaller than its peak value by a factor of approx. 7. We determine that no radio-loud spectrally flat blazar is within the error box of GRO J1838-04. We discuss the origin of the gamma-ray transient source and show that interpretations in terms of active galactic nuclei or isolated pulsars are highly problematic. GRO J1838-04 provides strong evidence for the existence of a new class of variable gamma-ray sources.

Author

Gamma Rays; Active Galactic Nuclei; Blazars; Pulsars

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Timing the Geminga Pulsar with EGRET Data

Mattox, J. R., Columbia Univ., USA; Halpern, Jules P., Columbia Univ., USA; Caraveo, P. A., Columbia Univ., USA; The New X-Ray/Gamma-Ray Pulsars; May 2001, pp. 5; Repr. from Astronomy and Astrophysics Supplements, v. 120, 1996 p C77; In English

Contract(s)/Grant(s): NAG5-3229; Copyright; Avail: Issuing Activity; Abstract Only

The pulsation of Geminga has been detected to date only at high energies (E greater than 0.1 keV). Since X-ray exposures are short and Geminga is at best only marginally detected in gamma-rays at E less than 30 MeV, the primary means of timing Geminga is with high-energy gamma-rays. The EGRET observations of Geminga now span 4 years. These data are analyzed to determine the 1995 ephemeris for Geminga which is provided here. We continue to count every revolution of Geminga during the GRO mission with a rotational phase resolution which improves with additional exposure. Proper motion is now apparent in the gamma-ray timing, consistent with the optical measurement of Bignami et al. With improved statistics, two addition peaks are tentatively detected in the ”minor bridge” region. More exposure is required to confirm them. If found to be real, they are difficult to understand with polar cap models, but are expected for the outer gap model, and provide sorely needed constraints.

Author

Pulsars; X Rays; Gamma Rays; Exposure

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A Possible X-Ray Detection of the Binary Millisecond Pulsar J1012+5307

Halpern, Jules P., Columbia Univ., USA; The New X-Ray/Gamma-Ray Pulsars; May 2001, pp. 4; Repr. from The Astrophysical Journal, v. 459, 1996 p L9; In English

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A possible X-ray detection of the newly discovered binary millisecond radio pulsar PSR J1012+5307 was obtained from an archival ROSAT observation. The 80 +/- 24 photons detected correspond to a 0.1 - 2.4 keV luminosity of approx. = 2.5 x 10(exp 30) erg/s at the nominal dispersion-measure distance of 520 pc. This luminosity is a factor of 2 less than that of PSR J0437-4715, a near twin of PSR J1012+5307 in its spin parameters and energetics, and the only millisecond pulsar from which pulsed X-rays have definitely been detected. PSR J1012+5307 is also within 6 deg of the ”HI hole” in Ursa Major, providing a new estimate of the electron column density through this region which confirms that the ionized column density is also low. The small neutral column density to PSR J1012+5307, N(sub H) less than 7.5 x 10(exp 19)/sq cm, will facilitate future soft X-ray study, which will help to discriminate between thermal and nonthermal origins of the X-ray emission in millisecond pulsars.

Author

X Rays; Detection; Pulsars

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Timing the Geminga Pulsar with Gamma-Ray Observations

Mattox, J. R., Columbia Univ., USA; Halpern, Jules P., Columbia Univ., USA; Caraveo, P. A., Columbia Univ., USA; The New X-Ray/Gamma-Ray Pulsars; May 2001, pp. 7-8; Repr. from The Astrophysical Journal, v. 493, 1998 p 891; In English

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We present the COS-B/EGRET 1997 ephemeris for the rotation of the Geminga pulsar. This ephemeris is derived from high-energy gamma-ray observations that span 24 yr. The recently obtained accurate position and proper motion are assumed. A cubic ephemeris predicts the rotational phase of Geminga with errors smaller than 50 milliperiods for all existing high-energy gamma-ray observations that span a 24.2 yr timing baseline. The braking index obtained is 17 +/- 1. Further observation is required to ascertain whether this high value truly reflects the rotational energy loss mechanism, or whether it is a manifestation of timing noise. The ephemeris parameters are sufficiently constrained so that timing noise will be the limitation on forward extrapolation. If Geminga continues to rotate without a glitch, as it has for at least 23 yr, we expect this ephemeris to continue to describe the phase, with an error of less than 100 milliperiods, until 2008. Statistically significant timing residuals are detected in the EGRET data that depart from the cubic ephemeris at a level of 30 milliperiods. Although this could simply be an additional manifestation of timing noise, the EGRET timing residuals appear to have a sinusoidal modulation that is consistent with a planet of mass 1.7/sin i solar mass, orbiting Geminga at a radius of 3.3 AU.
Author
Pulsars; Energy Dissipation; Gamma Rays; Modulation; Sine Waves; Time Dependence

20010055706 Columbia Univ., Columbia Astrophysics Lab., New York, NY USA
A Possible X-Ray and Radio Counterpart of the High-Energy Gamma-Ray Source 3EG J2227+6122
Halpern, Jules P., Columbia Univ., USA; Gotthelf, E. V., Columbia Univ., USA; Helfand, D. J., Columbia Univ., USA; Leighly, K. M., Columbia Univ., USA; The New X-Ray/Gamma-Ray Pulsars; May 2001, pp. 13-14; Repr. from The Astrophysical Journal, v. 547, 2001 p 323; In English
Contract(s)/Grant(s): NAG5-3229; Copyright; Avail: Issuing Activity; Abstract Only

The identity of the persistent EGRET sources in the Galactic plane is largely a mystery. For one of these, 3EG J2227+6122, our complete census of X-ray and radio sources in its error circle reveals a remarkable superposition of an incomplete radio shell with a flat radio spectrum, and a compact, power-law X-ray source with photon index Gamma = 1.5 and with no obvious optical counterpart. The radio shell is polarized at a level of approx. = 25%. The anomalous properties of the radio source prevent us from deriving a completely satisfactory theory as to its nature. Nevertheless, using data from ROSAT, ASCA, the VLA, and optical imaging and spectroscopy, we argue that the X-ray source may be a young pulsar with an associated wind-blown bubble or bow shock nebula, and an example of the class of radio-quiet pulsars which are hypothesized to comprise the majority of EGRET sources in the Galaxy. The distance to this source can be estimated from its X-ray absorption as 3 kpc. At this distance, the X-ray and gamma-ray luminosities would be approx. = 1.7 x 10(exp 33) and approx. = 3.7 x 10(exp 35) erg/s, respectively, which would require an energetic pulsar to power them. If, on the contrary, this X-ray source is not the counterpart of 3EG J2227+6122, then by process of elimination the X-ray luminosity of the latter must be less than 10(exp -4) of its gamma-ray luminosity, a condition not satisfied by any established class of gamma-ray source counterpart. This would require the existence of at least a quantitatively new type of EGRET source, as has been suggested in studies of other EGRET fields.
Author
X Ray Sources; Radio Spectra; Gamma Rays; Wind Effects; Supernova Remnants; Pulsars; Imaging Techniques; Galaxies

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HST/NICMOS Observations of PSR B0656+14 and Geminga
Harlow, J. J. B., Columbia Univ., USA; Pavlov, G. G., Columbia Univ., USA; Halpern, Jules P., Columbia Univ., USA; The New X-Ray/Gamma-Ray Pulsars; May 2001, pp. 10; Repr. from Bulletin of the American Astronomical Society, v. 193, 1998 p 41.07; In English
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We present results of March 1998 NICMOS observations of two middle-aged pulsars, PSR B0656+14 and Geminga, with three and two broad-band filters, respectively. The infrared fluxes of both objects grow with increasing wavelength, Most likely they are generated in the pulsars' magnetospheres. Composite UV/optical/IR spectral fluxes of the pulsars demonstrate that the radiation in this wavelength range cannot be described by a simple one-component model.
Author
Pulsar Magnetospheres; Ultraviolet Spectra; Age Factor

20010055709 Columbia Univ., Columbia Astrophysics Lab., New York, NY USA
Models for X-Ray Emission from Isolated Pulsars
Wang, F. Y.-H., Columbia Univ., USA; Ruderman, M., Columbia Univ., USA; Halpern, Jules P., Columbia Univ., USA; Zhu, T., Columbia Univ., USA; The New X-Ray/Gamma-Ray Pulsars; May 2001, pp. 8-9; Repr. from The Astrophysical Journal, v. 498, 1998 p 373; In English
Contract(s)/Grant(s): NAG5-3229; Copyright; Avail: Issuing Activity; Abstract Only

A model is proposed for the observed combination of power-law and thermal X-rays from rotationally powered pulsars. For gamma-ray pulsars with accelerators very many stellar radii above the neutron star surface, 100 MeV curvature gamma-rays from e(-) or e(+) flowing starward out of such accelerators are converted to e1 pairs on closed field lines all around the star. These pairs strongly affect X-ray emission from near the star in two ways. (1) The pairs are a source of synchrotron emission immediately following their creation in regions where B approx. 10(exp 10) G. This emission, in the photon energy range 0.1 keV less than E(sub X) less than 5 MeV, has a power-law spectrum with energy index 0.5 and X-ray luminosity that depends on the back-flow current, and is typically approx. 10(exp 33) ergs/ s. (2) The pairs ultimately a cyclotron resonance ”blanket” surrounding the star except for two holes along the open field line bundles which pass through it. In such a blanket the gravitational pull on e(+,-) pairs toward the star is balanced by the hugely amplified push of outflowing surface emitted X-rays wherever cyclotron resonance occurs. Because of it the neutron star is surrounded by a leaky ”hohlraum” of hot blackbody radiation with two small holes, which prevents direct X-ray observation of a heated polar cap of a gamma-ray pulsar. Weakly spin modulated radiation from the blanket together with more strongly spin-modulated radiation from the holes through it would then dominate observed low energy (0.1-10 keV) emission. For non-y-ray pulsars, in which no such accelerators with their accompanying extreme relativistic back-flow toward the star are expected, optically thick e1 resonance blankets should not form (except in special cases very close to the open field line bundle). From such pulsars blackbody radiation from both the warm stellar surface and the heated polar caps should be directly observable. In these pulsars, details of the surface magnetic field evolution, especially of polar cap areas, become relevant to observations. The models are compared to X-ray data from Geminga, PSR 1055-52, PSR 0656+14, PSR 1929+10, and PSR 0950+08.
Author
Models; X Rays; Emission; Pulsars; Spectra; Gamma Rays

20010055710 Columbia Univ., Columbia Astrophysics Lab., New York, NY USA
Soft X-Ray Properties of the Binary Millisecond Pulsar J0437-4715
Halpern, Jules P., Columbia Univ., USA; Martin, Christopher, Columbia Univ., USA; Marshall, Herman, L., Columbia Univ., USA; The New X-Ray/Gamma-Ray Pulsars; May 2001, pp. 4; Repr. from Astrophysical Journal, v. 462, 1996 p 908; In English Contract(s)/Grant(s): NAG5-3229; Copyright; Avail: Issuing Activity; Abstract Only

We obtained a light curve for the 5.75 ms pulsar J0437-4715 in the 65-120 A range with 0.5 ms time resolution using the Deep Survey instrument on the EUVE satellite. The single-peaked profile has a pulsed fraction of 0.27 +/- 0.05, similar to the ROSAT data in the overlapping energy band. A combined analysis of the EUVE and ROSAT data is consistent with a power-law spectrum of energy index alpha = 1.2 - 1.5, intervening column density N(sub H) = (5 - 8) x 10(exp 19)/sq cm, and luminosity 5.0 x 10(exp 30) ergs/s in the 0.1 - 2.4 keV band. We also use a bright EUVE/ROSAT source only 4.2 min. from the pulsar, the Seyfert galaxy RX J0437.4-4711 (= EUVE J0437-471 = IES 0435-472), to obtain an independent upper limit on the intervening absorption to the pulsar, N(sub H) less than 1.2 x 10(exp 20)/sq cm. Although a blackbody spectrum fails to fit the ROSAT data, two-component spectral fits to the combined EUVE/ROSAT data are used to limit the temperatures and surface areas of thermal emission that might make partial contributions to the flux. A hot polar cap of radius 50 - 600 m and temperature (1.0 - 3.3) x 10(exp 6) K could be present. Alternatively, a larger region with T = (4 - 12) x 10(exp 5) K and area less than 200 sq km, might contribute most of the EUVE and soft X-ray flux, but only if a hotter component were present as well. Any of these temperatures would require some mechanism(s) of surface reheating to be operating in this old pulsar, the most plausible being the impact of accelerated electrons and positrons onto the polar caps. The kinematically corrected spin-down power of PSR J0437-4715 is only 4 x 10(exp 33) ergs/s, which is an order of magnitude less than that of the lowest-luminosity gamma-ray pulsars Geminga and PSR B1055-52. The absence of high-energy gamma-rays from PSR J0437-4715 might signify an inefficient or dead outer gap accelerator, which in turn accounts for the lack of a more luminous reheated surface such as those intermediate-age gamma-ray pulsars may have.
Author
Energy Bands; Gamma Rays; Polar Caps; Pulsars; Spectra; Temporal Resolution; Thermal Emission; X Ray Binaries

20010057600 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA USA
The Nearest GHz Peaked-Spectrum Radio Galaxy, PKS 1718-649
Tingay, S. J., Jet Propulsion Lab., California Inst. of Tech., USA; Jauncey, D. L., Commonwealth Scientific and Industrial Research Organization, Australia; Reynolds, J. E., Commonwealth Scientific and Industrial Research Organization, Australia; Tzioumis, A. K., Commonwealth Scientific and Industrial Research Organization, Australia; King, E. A., Commonwealth Scientific and Industrial Research Organization, Australia; Preston, R. A., Jet Propulsion Lab., California Inst. of Tech., USA; Lovell, J. E., Tasmania Univ., Australia; McCulloch, P. M., Tasmania Univ., Australia; Costa, M. E., Tasmania Univ., Australia; Nicolson, G., Hartebeesthoek Radio Astronomy Observatory, South Africa; Astronomical Journal; June 1997; ISSN 0004-6256; Volume 113, No. 6, pp. 2025-2030; In English; Copyright; Avail: Issuing Activity

In this paper we identify PKS 1718-649, at a distance of 56 Mpc (z = 0.014; H(sub o) = 75 km/s/Mpc, q(sub o) = 0), as the nearest GHz peaked-spectrum (GPS) radio galaxy, more than four times closer than any previously known. Extensive observations at radio wavelengths with the Australia Telescope Compact Array, the Southern Hemisphere VLBI Experiment array, and the Swedish-ESO Submillimetre Telescope have allowed us to determine the properties of the radio source: PKS 1718-649 consists of two compact sub-pc-scale components separated by approximately 2 pc, the overall radio polarization is low, and the radio spectrum is peaked near 3 GHz. Order-of-magnitude agreement between the quantitative model for GPS sources of Bicknell et al. and the radio data we present, as well as data at optical wavelengths from the literature, raises the interesting possibility that PKS 1718-649 may be frustrated in its development by the nuclear environment of its host galaxy, NGC 6328. The model of Bicknell et al. suggests free-free absorption as an explanation of the PKS 1718-649 radio spectrum. However, both free-free absorption and synchrotron self-absorption mechanisms are plausible for this source and both may contribute to the overall radio spectrum. PKS 1718-649 provides evidence to strengthen the speculative suggestion that GPS sources arise as a consequence of galaxy merger activity.
Author
Radio Galaxies; Radio Spectra; Radio Astronomy

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