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Langley Research Center
Scientific and Technical Information Program Office

Scientific and Technical Aerospace Reports

STAR

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NASA STI Program ... in Profile

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- TECHNICAL MEMORANDUM. Scientific and technical findings that are of preliminary or specialized interest, e.g., quick release reports, working papers, and bibliographies that contain minimal annotation. Does not contain extensive analysis.
- CONTRACTOR REPORT. Scientific and technical findings by NASA-sponsored contractors and grantees.
- CONFERENCE PUBLICATION. Collected papers from scientific and technical conferences, symposia, seminars, or other meetings sponsored or co-sponsored by NASA.
- SPECIAL PUBLICATION. Scientific, technical, or historical information from NASA programs, projects, and missions, often concerned with subjects having substantial public interest.
- TECHNICAL TRANSLATION. English-language translations of foreign scientific and technical material pertinent to NASA's mission.

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  Hanover, MD 21076-1320

Introduction

Scientific and Technical Aerospace Reports (*STAR*) is an online information resource listing citations and abstracts of NASA and world wide aerospace-related STI. Updated biweekly, *STAR* highlights the most recent additions to the NASA Aeronautics and Space Database. Through this resource, the NASA STI Program provides timely access to the most current aerospace-related Research & Development (R&D) results.

STAR subject coverage includes all aspects of aeronautics and space research and development, supporting basic and applied research, and application, as well as aerospace aspects of Earth resources, energy development, conservation, oceanography, environmental protection, urban transportation and other topics of high national priority. The listing is arranged first by 11 broad subject divisions, then within these divisions by 76 subject categories and includes two indexes: subject and author.

STAR includes citations to Research & Development (R&D) results reported in:

- NASA, NASA contractor, and NASA grantee reports
- Reports issued by other U.S. Government agencies, domestic and foreign institution, universities, and private firms
- Translations
- NASA-owned patents and patent applications
- Other U.S. Government agency and foreign patents and patent applications
- Domestic and foreign dissertations and theses

The NASA STI Program

The NASA Scientific and Technical Information (STI) Program was established to support the objectives of NASA's missions and research to advance aeronautics and space science. By sharing information, the NASA STI Program ensures that the U.S. maintains its preeminence in aerospace-related industries and education, minimizes duplication of research, and increases research productivity.

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NASA STI Availability Information

NASA Center for AeroSpace Information (CASI)

Through NASA CASI, the NASA STI Program offers many information products and services to the aerospace community and to the public, including access to a selection of full text of the NASA STI. Free registration with the program is available to NASA, U.S. Government agencies and contractors. To register, contact CASI at help@sti.nasa.gov. Others should visit the program at www.sti.nasa.gov. The 'search selected databases' button provides access to the NASA Technical Reports Server (TRS) – the publicly available contents of the NASA Aeronautics and Space Database.

Each citation in *STAR* indicates a 'Source of Availability'. When CASI is indicated, the user can order this information directly from CASI using the STI Online Order Form or contact help@sti.nasa.gov or telephone the CASI Help Desk at 301-621-0390. Before ordering you may access price code tables for STI documents and videos. When information is not available from CASI, the source of the information is indicated when known.

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National Technical Information Service (NTIS)

The National Technical Information Service serves the American public as a central resource for unlimited, unclassified U.S. Government scientific, technical, engineering, and business related information. For more than 50 years NTIS has provided businesses, universities, and the public timely access to well over 2 million publications covering over 350 subject areas. Visit NTIS at http://www.ntis.gov.

The Federal Depository Library Program (FDLP)

The U.S. Congress established the **Federal Depository Library Program** (FDLP) to ensure access by the American public to U.S. Government information. The program acquires and disseminates information products from all three branches of the U.S. Government to nearly 1,300 Federal depository libraries nationwide. The libraries maintain these information products as part of their existing collections and are responsible for assuring that the public has free access to the information. Locate the Federal Depository Libraries http://www.access.gpo.gov/su_docs.

The U.S. Patent and Trademark Office (USPTO)

The U.S. Patent and Trademark Office provides online access to full text patents and patent applications. The database includes patents back to 1976 plus some pre-1975 patents. Visit the USPTO at http://www.uspto.gov/patft/.

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SCIENTIFIC AND TECHNICAL AEROSPACE REPORTS

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01
AERONAUTICS (GENERAL)

Includes general research topics related to manned and unmanned aircraft and the problems of flight within the Earth's atmosphere. Also includes manufacturing, maintenance, and repair of aircraft. For specific topics in aeronautics, see *categories 02 through 09*. For information related to space vehicles *see 12 Astronautics*.

20030068074 NASA Glenn Research Center, Cleveland, OH, USA

2002 Computing and Interdisciplinary Systems Office Review and Planning Meeting

Lytle, John; Follen, Gregory; Lopez, Isaac; Veres, Joseph; Lavelle, Thomas; Sehra, Arun; Freeh, Josh; Hah, Chunill; August 2003; 187 pp.; In English; 2002 CISO Review and Planning Meeting, 9-10 Oct. 2002, Middleburg Heights, OH, USA; See also 20030068075 - 20030068088

Contract(s)/Grant(s): WBS 22-704-40-01

Report No.(s): NASA/TM-2003-211896; E-13578; NAS 1.15:211896; No Copyright; Avail: CASI; A09, Hardcopy

The technologies necessary to enable detailed numerical simulations of complete propulsion systems are being developed at the NASA Glenn Research Center in cooperation with NASA Glenn s Propulsion program, NASA Ames, industry, academia and other government agencies. Large scale, detailed simulations will be of great value to the nation because they eliminate some of the costly testing required to develop and certify advanced propulsion systems. In addition, time and cost savings will be achieved by enabling design details to be evaluated early in the development process before a commitment is made to a specific design. This year s review meeting describes the current status of the NPSS and the Object Oriented Development Kit with specific emphasis on the progress made over the past year on air breathing propulsion applications for aeronautics and space transportation applications. Major accomplishments include the first 3-D simulation of the primary flow path of a large turbofan engine in less than 15 hours, and the formal release of the NPSS Version 1.5 that includes elements of rocket engine systems and a visual based syntax layer. NPSS and the Development Kit are managed by the Computing and Interdisciplinary Systems Office (CISO) at the NASA Glenn Research Center and financially supported in fiscal year 2002 by the Computing, Networking and Information Systems (CNIS) project managed at NASA Ames, the Glenn Aerospace Propulsion and Power Program and the Advanced Space Transportation Program.

Author

Space Transportation; Aerodynamics; Propulsion System Configurations; Engine Design; Air Breathing Engines

20030068279 Nebraska Univ., Omaha, NE, USA

Aeronautics Education, Research, and Industry Alliance (AERIAL) Year 2 Report and Year 3 Proposal

Bowen, Brent D.; Box, Richard C.; Fink, Mary M.; Gogos, Geroge; Lehrer, Henry R.; Narayanan, Ram M.; Nickerson, Jocelyn S.; Tarry, Scott E.; Vlasek, Karisa D.; 2003; 64 pp.; In English

Report No.(s): UNOAI-Rept-03-2; Copyright; Avail: CASI; A04, Hardcopy

The Aeronautics Education, Research, and Industry Alliance (AERIAL): a comprehensive, multi-faceted NASA EPSCoR 2000 initiative, contributes to the strategic research and technology priorities of NASA while intensifying Nebraska s rapidly growing aeronautics research and development endeavors. AERIAL enables Nebraska researchers to: (a) continue strengthening their collaborative relationships with NASA Field Centers, Codes, and Enterprises; (b) increase the capacity of higher education throughout Nebraska to invigorate and expand aeronautics research; and (c) expedite the development of aeronautics-related research infrastructure and industry in the state. This report contains a summary of AERIAL's activities and accomplishments during the second year of implementation. The AERIAL Year 3 proposal is also included.

Derived from text

Education; Reports; Aeronautics; Aerospace Industry; Research And Development

20030068339 Cox and Co., Inc., New York, NY, USA

Assessment of Effects of Mixed-Phase Icing Conditions on Thermal Ice Protection Systems

Al-Khalil, K.; May 2003; In English

Report No.(s): PB2003-106631; No Copyright; Avail: National Technical Information Service (NTIS)

The Federal Aviation Administration sponsored a preliminary experimental research program to study the effects of mixed-phase and fully glaciated icing conditions on the performance of thermal anti-icing ice protection systems (IPS). The experimental investigation was limited to a 36-inch chord NACA 0012 airfoil that was equipped with a leading-edge electrothermal ice protection system. The testing was accomplished at the Cox & Company, LeClerc Icing Research Laboratory tunnel, using the laboratory's newly developed capability to simulate mixed-phase icing conditions in their tunnel. Chordwise power required to operate the IPS in the evaporative mode (with an IPS surface temperature of 150 F) and in the running wet mode (with an IPS surface temperature of 50 F) was recorded with a model angle of attack of 0 and with supercooled liquid, mixed-phase, and glaciated conditions at temperatures of 0 and 12 F. Photographic records of the ice accretion and ice protection phenomena, using newly developed optical techniques, were obtained by the National Aeronautical and Space Administration Glenn Research Center Icing Branch. This report describes the test program and summarizes the associated results.

NTIS

Thermal Protection; Ice Formation

02
AERODYNAMICS

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 Thermodynamics*.

20030067941 NASA Langley Research Center, Hampton, VA, USA

Vortex Flows at Supersonic Speeds

Wood, Richard M.; Wilcox, Floyd J., Jr.; Bauer, Steven X. S.; Allen, Jerry M.; March 1, 2003; 100 pp.; In English

Contract(s)/Grant(s): WU 706-51-21-10

Report No.(s): NASA/TP-2003-211950; L-18008; NAS 1.60:211950; No Copyright; Avail: CASI; A05, Hardcopy

A review of research conducted at the National Aeronautics and Space Administration (NASA) Langley Research Center (LaRC) into high-speed vortex flows during the 1970s, 1980s, and 1990s is presented. The data are for flat plates, cavities, bodies, missiles, wings, and aircraft with Mach numbers of 1.5 to 4.6. Data are presented to show the types of vortex structures that occur at supersonic speeds and the impact of these flow structures on vehicle performance and control. The data show the presence of both small- and large-scale vortex structures for a variety of vehicles, from missiles to transports. For cavities, the data show very complex multiple vortex structures exist at all combinations of cavity depth to length ratios and Mach number. The data for missiles show the existence of very strong interference effects between body and/or fin vortices. Data are shown that highlight the effect of leading-edge sweep, leading-edge bluntness, wing thickness, location of maximum thickness, and camber on the aerodynamics of and flow over delta wings. Finally, a discussion of a design approach for wings that use vortex flows for improved aerodynamic performance at supersonic speeds is presented.

Author

Aerodynamic Characteristics; Vortices; Supersonic Speed; Swept Wings; Delta Wings

20030067951 National Center for Atmospheric Research, Boulder, CO, USA

Influence of Idealized Heterogeneity on Wet and Dry Planetary Boundary Layers Coupled to the Land Surface, 1, Instantaneous Fields and Statistics

Houser, Paul, Technical Monitor; Patton, Edward G.; Sullivan, Peter P.; Moeng, Chin-Hoh; [2003]; 53 pp.; In English

Contract(s)/Grant(s): NAG5-8839

Report No.(s): NCAR-1998-290; No Copyright; Avail: CASI; A04, Hardcopy

This is the first in a two-part series of manuscripts describing numerical experiments on the influence of 2-30 km striplike heterogeneity on wet and dry boundary layers coupled to the land surface. The strip-like heterogeneity is shown to dramatically alter the structure of the free-convective boundary layer by inducing significant organized circulations that modify turbulent statistics. The coupling with the land-surface modifies the circulations compared to previous studies using fixed surface forcing. Total boundary layer turbulence kinetic energy increases significantly for surface heterogeneity at scales

between Lambda/z(sub i) = 4 and 9, however entrainment rates for all cases are largely unaffected by the strip-like heterogeneity.
Author
Boundary Layers; Free Convection; Heterogeneity; Turbulence

20030068030 NASA Langley Research Center, Hampton, VA, USA
Evaluation of Flush-Mounted, S-Duct Inlets With Large Amounts of Boundary Layer Ingestion
Berrier, Bobby L.; Morehouse, Melissa B.; [2003]; 13 pp.; In English; Symposium on Vehicle Propulsion Integration, 6-9 Oct. 2003, Warsaw, Poland
Report No.(s): Paper 38; No Copyright; Avail: CASI; A03, Hardcopy

A new high Reynolds number test capability for boundary layer ingesting inlets has been developed for the NASA Langley Research Center 0.3-Meter Transonic Cryogenic Tunnel. Using this new capability, an experimental investigation of four S-duct inlet configurations with large amounts of boundary layer ingestion (nominal boundary layer thickness of about 40% of inlet height) was conducted at realistic operating conditions (high subsonic Mach numbers and full-scale Reynolds numbers). The objectives of this investigation were to 1) develop a new high Reynolds number, boundary-layer ingesting inlet test capability, 2) evaluate the performance of several boundary layer ingesting S-duct inlets, 3) provide a database for CFD tool validation, and 4) provide a baseline inlet for future inlet flow-control studies. Tests were conducted at Mach numbers from 0.25 to 0.83, Reynolds numbers (based on duct exit diameter) from 5.1 million to a fullscale value of 13.9 million, and inlet mass-flow ratios from 0.39 to 1.58 depending on Mach number. Results of this investigation indicate that inlet pressure recovery generally decreased and inlet distortion generally increased with increasing Mach number. Except at low Mach numbers, increasing inlet mass-flow increased pressure recovery and increased distortion. Increasing the amount of boundary layer ingestion (by decreasing inlet throat height and increasing inlet throat width) or ingesting a boundary layer with a distorted profile decreased pressure recovery and increased distortion. Finally, increasing Reynolds number had almost no effect on inlet distortion but increased inlet recovery by about one-half percent at a Mach number near cruise.
Author
Boundary Layers; Engine Inlets; Inlet Pressure; Inlet Flow; Cryogenics; Aerodynamic Configurations

20030068262 NASA Glenn Research Center, Cleveland, OH, USA
A Time Domain Analysis of Gust-Cascade Interaction Noise
Nallasamy, M.; Hixon, R.; Sawyer, S. D.; Dyson, R. W.; July 2003; 19 pp.; In English; Ninth Aeroacoustics Conference and Exhibit, 12-14 May 2003, Hilton Head, SC, USA; Original contains color and black and white illustrations
Contract(s)/Grant(s): WBS-22-781-30-09
Report No.(s): NASA/TM-2003-212509; NAS 1.15:212509; E-14069; AIAA Paper 2003-3134; Copyright; Avail: CASI; A03, Hardcopy

The gust response of a 2 D cascade is studied by solving the full nonlinear Euler equations employing higher order accurate spatial differencing and time stepping techniques. The solutions exhibit the exponential decay of the two circumferential mode orders of the cutoff blade passing frequency (BPF) tone and propagation of one circumferential mode order at 2BPF, as would be expected for the flow configuration considered. Two frequency excitations indicate that the interaction between the frequencies and the self interaction contribute to the amplitude of the propagating mode.
Author
Aerodynamic Noise; Time Domain Analysis; Gusts

20030068266 Swedish Defence Research Establishment, Stockholm
Ramjet Missile Project, Calculation of Additional Aerodata for Rb73
Tormalm, M.; Feb. 2002; In Swedish
Report No.(s): PB2003-103164; FOI-R-0373-SE; No Copyright; Avail: National Technical Information Service (NTIS)

This report describes the validation of a ramjet engine integration into FFA's CFD code EDGE. An aerodynamic database has been calculated for a ramjet missile, Rb73 and compared with data from VAC. Previous CFD computations of the same missile showed differences between the inlets used on the CFD model and the VAC data. The missile inlet area was therefore changed on the CFD model and used in this investigation. The result shows that there still exist differences between the FFA calculations and the VAC reference data. The cause is other geometrical differences, mainly the rudder and the inlet compression ramp. This resulted in higher drag and less massflow for the CFD model. Another critical factor is the fixed bleed that has been used in the CFD computations which also gives less massflow. Even if the current investigation could not

validate the VAC data, the ramjet method shows good potential. The differences seen can be explained with handbook methods. The only factor that still is not solved is the bleed flow. This requires separate intake computations and integration of bleed model.
NTIS
Computational Fluid Dynamics; Ramjet Engines; Ramjet Missiles

20030068347 Federal Aviation Administration, Atlantic City, NJ, USA
Complexity in Air Traffic Control Towers: A Field Study, Part 1, Complexity Factors
Koros, A.; Della Rocco, P. S.; Panjwani, G.; Ingurgio, V.; DArcy, J. F.; May 2003; In English
Report No.(s): PB2003-106638; DOT/FAA/CT-TN03/14-Pt-1; No Copyright; Avail: National Technical Information Service (NTIS)

This study investigated factors that contribute to complexity and their incidence within Federal Aviation Administration Air Traffic Control Towers (ATCTs). Human Factors Specialists from the William J. Hughes Technical Center selected six sites representing a combination of high traffic volume, traffic mix, and/or converging runways. Sixty-two Air Traffic Control Specialists (ATCSs) from the six ATCTs rated 29 complexity factors from local and ground controller perspective. The relative contribution of each of the complexity factors was site- and position-specific. High traffic volume, frequency congestion, and runway/taxiway configuration were among the leading complexity factors at all sites and for both control positions. This study characterized the differences between facilities in terms of the key factors and their incidence and summarized the interview data describing the nature of the complexity. An enhanced understanding of ATCSs decision making and tower complexity factors will help researchers predict the impact of automation and emerging technologies on controllers and ensure the continued safety and efficiency of the National Airspace System.
NTIS
Human Factors Engineering; Air Transportation; Air Traffic Controllers (Personnel); Civil Aviation

20030068383 NASA Ames Research Center, Moffett Field, CA, USA
A Study of Dynamic Stall Vortex Development Using Two-Dimensional Data from the AFDD Oscillating Wing Experiment
Rhee, Myung J.; December 2002; 98 pp.; In English
Contract(s)/Grant(s): RTOP 712-10-12
Report No.(s): NASA/TM-2002-211857; NAS 1.15:211857; A-0208717; AFDD/TR-02-A-009; No Copyright; Avail: CASI; A05, Hardcopy

The purpose of this study is to examine the previously unpublished instantaneous pressure data of the Aeroflightdynamics Directorate Two-Dimensional (2D) and Three-Dimensional (3D) Oscillating Wing Experiment to better understand the process of dynamic stall vortex development on the NACA 0015 airfoil. This report presents representative 2D instantaneous pressure data for the upper and lower surfaces of the airfoil at various chordwise locations obtained at specific angles of attack during upstroke and downstroke cycles. Furthermore, the report contains a complete set of plots of instantaneous pressure distributions for the upper surface for all the 2D data sets obtained in the experiment. First, the lift, drag and pitching moment data of various testing conditions are reviewed and analyzed to classify the data both with and without a boundary layer trip into 'no stall,' 'moderate stall,' and 'deep stall' data. Next, instantaneous pressure distributions on the upper surface of the airfoil are examined for the study of vortex development. The lift and pitching moment data are analyzed to document the dynamic overshoot which delays the development of the stall on the airfoil. Next, the range of angled of attack are selected where the lift and pitching moment data shows significant changed for unsteady flow behavior during oscillation cycles. Furthermore based on the unsteady flow characteristics found in each classification of dynamic stall, analysis is continued to identify the conditions where the reduced frequency clearly affects the unsteady flow behavior of the airfoil during the oscillation. This can result in a change of the dynamic stall classification of the airfoil response under various unsteady flow conditions. These conditions are discussed in detail in the comparative studies.
Author
Oscillating Flow; Wings; Aerodynamic Stalling; Two Dimensional Flow; Flow Characteristics; Vortices; Wind Tunnel Tests

20030068449
Drag Reduction by Suction of the Boundary Layer Separated Behind Shock Wave Formation at High Mach Numbers
Regenscheit, B.; July 1947; 21 pp.; In English; Original contains black and white illustrations
Report No.(s): NACA-TM-1168; ZWB-1424; No Copyright; Avail: CASI; A03, Hardcopy

With an approach of the velocity of flight of a ship to the velocity of sound, there occurs a considerable increase of the drag. The reason for this must be found in the boundary layer separation caused by formation of shock waves. It will be endeavored to reduce the drag increase by suction of the boundary layer. Experimental results showed that drag increase may be considerably reduced by this method. It was, also, observed that, by suction, the position of shock waves can be altered to a considerable extent.
Author
Aerodynamic Drag; Drag Reduction; Suction; Shock Waves; Boundary Layer Separation

20030068452 NASA Ames Research Center, Moffett Field, CA, USA
Aerodynamic Design of Complex Configurations Using Cartesian Methods and CAD Geometry
Nemec, Marian; Aftosmis, Michael J.; Pulliam, Thomas H.; [2003]; 6 pp.; In English; 42nd AIAA Aerospace Sciences Meeting, Jan 5-8, 2004, Reno, NV, USA; No Copyright; Avail: CASI; A02, Hardcopy

The objective for this paper is to present the development of an optimization capability for the Cartesian inviscid-flow analysis package of Aftosmis et al. We evaluate and characterize the following modules within the new optimization framework: (1) A component-based geometry parameterization approach using a CAD solid representation and the CAPRI interface. (2) The use of Cartesian methods in the development Optimization techniques using a genetic algorithm. The discussion and investigations focus on several real world problems of the optimization process. We examine the architectural issues associated with the deployment of a CAD-based design approach in a heterogeneous parallel computing environment that contains both CAD workstations and dedicated compute nodes. In addition, we study the influence of noise on the performance of optimization techniques, and the overall efficiency of the optimization process for aerodynamic design of complex three-dimensional configurations. of automated optimization tools. rithm and a gradient-based algorithm.
Derived from text
Aerodynamics; Aircraft Design; Algorithms; Body-Wing Configurations

20030068780 NASA Ames Research Center, Moffett Field, CA, USA
A Methodology for Flight-Time Identification of Helicopter-Slung Load Frequency Response Characteristics Using CIFER
Sahai, Ranjana; Pierce, Larry; Cicolani, Luigi; Tischler, Mark; January 25, 1998; 1 pp.; In English; AIAA GNC Conference, August 1999, Portland, OR, USA
Contract(s)/Grant(s): RTOP 581-30-32; No Copyright; Avail: Other Sources; Abstract Only

Helicopter slung load operations are common in both military and civil contexts. The slung load adds load rigid body modes, sling stretching, and load aerodynamics to the system dynamics, which can degrade system stability and handling qualities, and reduce the operating envelope of the combined system below that of the helicopter alone. Further, the effects of the load on system dynamics vary significantly among the large range of loads, slings, and flight conditions that a utility helicopter will encounter in its operating life. In this context, military helicopters and loads are often qualified for slung load operations via flight tests which can be time consuming and expensive. One way to reduce the cost and time required to carry out these tests and generate quantitative data more readily is to provide an efficient method for analysis during the flight, so that numerous test points can be evaluated in a single flight test, with evaluations performed in near real time following each test point and prior to clearing the aircraft to the next point. Methodology for this was implemented at Ames and demonstrated in slung load flight tests in 1997 and was improved for additional flight tests in 1999. The parameters of interest for the slung load tests are aircraft handling qualities parameters (bandwidth and phase delay), stability margins (gain and phase margin), and load pendulum roots (damping and natural frequency). A procedure for the identification of these parameters from frequency sweep data was defined using the CIFER software package. CIFER is a comprehensive interactive package of utilities for frequency domain analysis previously developed at Ames for aeronautical flight test applications. It has been widely used in the US on a variety of aircraft, including some primitive flight time analysis applications.
Derived from text
Military Helicopters; Aircraft Control; Control Stability; Helicopter Control; Aerodynamic Loads

20030068816 Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Berlin, Germany
Aerodynamic Research on Fuselages with Rectangular Cross Section
Maruhn, K.; Jahrbuch 1942 der Deutschen Luftfahrtforschung; July 1958, pp. 263-279; In English
Report No.(s): NACA-TM-1414; No Copyright; Avail: CASI; A03, Hardcopy

The influence of the deflected flow caused by the fuselage (especially by unsymmetrical attitudes) on the lift and the

rolling moment due to sideslip has been discussed for infinitely long fuselages with circular and elliptical cross section. The aim of this work is to add rectangular cross sections and, primarily, to give a principle by which one can get practically usable contours through simple conformal mapping. In a few examples, the velocity field in the wing region and the induced flow produced are calculated and are compared with corresponding results from elliptical and strictly rectangular cross sections. Author

Aerodynamics; Fuselages; Cross Sections; Contours; Conformal Mapping; Velocity Distribution; Wings

03
AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; airport 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*.

20030067704 Yuma Proving Ground, AZ

Environmental Assessment for Mohave Drop Zone

Sep. 27, 2001; 49 pp.; In English

Report No.(s): AD-A414674; No Copyright; Avail: CASI; A03, Hardcopy

The attached Environmental Assessment for the Mohave Drop Zone, September 2001, has been prepared to assess the potential environmental impacts associated with the Proposed Action of establishing a new drop zone in the north central Cibola Region at Yuma Proving Ground. The Proposed Action involves: 1) the construction of an additional access route and grading to improve an existing unnamed dirt road in the area; 2) the placement of a transportable office/ shelter outside the drop zone; and 3) the construction of two new observation sites.

DTIC

Air Drop Operations; Observation; Routes

20030067762 Nebraska Univ., Omaha, NE, USA

The Small Aircraft Transportation System (SATS): Research Collaborations with NASA Langley Research Center

Tarry, Scott E.; Bowen, Brent D.; Nickerson, Jocelyn S.; The Aeronautics Education, Research, and Industry Alliance (AERIAL) 2002 Report; November 2002, pp. 45-57; In English; See also 20030067758; No Copyright; Avail: CASI; A03, Hardcopy

The aviation industry is an integral part of the world s economy. Travelers have consistently chosen aviation as their mode of transportation as it is reliable, time efficient and safe. The out-dated Hub and Spoke system, coupled with high demand, has led to delays, cancellations and gridlock. NASA is developing innovative solutions to these and other air transportation problems. This research is being conducted through partnerships with federal agencies, industry stakeholders, and academia, specifically the University of Nebraska at Omaha. Each collaborator is pursuing the NASA General Aviation Roadmap through their involvement in the expansion of the Small Aircraft Transportation System (SATS). SATS will utilize technologically advanced small aircraft to transport travelers to and from rural and isolated communities. Additionally, this system will provide a safe alternative to the hub and spoke system, giving more time to more people through high-speed mobility and increased accessibility.

Author

Aircraft Industry; Air Transportation; General Aviation Aircraft

20030067942 Massachusetts Inst. of Tech., Cambridge, MA, USA

Air Traffic Control Response to Delays: A System Study of Newark International Airport

Evans, Antony D.; Clarke, John-Paul; [2002]; 14 pp.; In English; 21st IEEE and AIAA Digital Avionics Systems Conference, 27-31 Oct. 2003, Irvine, CA, USA

Contract(s)/Grant(s): NCC2-1147; No Copyright; Avail: CASI; A03, Hardcopy

Airport delays are a significant problem in the USA air transportation system. Between 1999 and 2000 the number of flights delayed increased by 20 percent despite only a 0.4% increase in total operations. Newark International Airport (EWR), one of New York City's primary airports, is one of the airports in the USA most impacted by delays. Newark had the highest percentage of operations delayed in 1999, and was second only to LaGuardia Airport in 2000. Nearly 85% of delays at Newark are caused by adverse weather impacting an airport that may be characterized as having limited capacity and a very full

schedule. Although Newark is heavily impacted by weather, delays have not increased significantly since 1998. This indicates that the airlines, air traffic control (ATC), and the Port Authority of New York and New Jersey have successfully adapted. On June 29, 2000, a research team from MIT visited Newark airport to assess the effectiveness of any adaptations made, and to collect data on airline and ATC departure operations, and of the national and local weather affecting the airport. Airline and ATC personnel were also interviewed. Results of this study indicate that airspace capacity limitations downstream of the airport are a primary flow constraint at the airport, and that these constraints are the source of most surface delays. A number of tactical ATC responses to delays were examined, including the application of restrictions, re-routing with the help of the National Playbook, and the use of decision-aiding tools such as the Dynamic Spacing Program (DSP) and the Integrated Terminal Weather System (ITWS). Improved interfacility communications and further utilization of runway 11-29 were identified as other tactical responses to delays, whilst the formation of the Air Traffic Control System Command Center and the New York Airspace redesign were identified as thekey strategic ATC responses to delays. Particularly the New York airspace redesign has great potential to reduce delays at the airport. Because delays at Newark are caused by downstream flow constraints, the responses at the airport can be applied to other airports as delays from downstream constraints increase. Such an increase in delays system wide from downstream constraints is inevitable as the system becomes more congested.
Author

Air Traffic Control; Airports; Delay; Air Transportation; Commercial Aircraft

20030067958 NASA Ames Research Center, Moffett Field, CA, USA

A Summary of Flightdeck Observer Data from SafeFlight 21 OpEval-2

Joseph, Kurt M.; Domino, David; Battiste, Vernol; Bone, Randall S.; Olmos, B. Oscar; February 2003; 60 pp.; In English
Contract(s)/Grant(s): DTFA02-01-P-05316; FAA-AM-B-00-HRR-516
Report No.(s): DOT/FAA/AM-03/2; No Copyright; Avail: CASI; A04, Hardcopy

The purpose of OpEval-2 was to demonstrate the use of COT1 and ADS-B and their expected benefits, which include increased safety, enhanced capacity, and greater efficiency. Three objectives were planned for OpEval-2. The first objective was to devc Dp and evaluate avionics and procedural modifications needed to support operational approval for the following applications: Initial and Final Approach Spacing, Departure Spacing, Final Approach and Runway Occupancy Awareness (FAROA), and Airport Surface Situation Awareness (ASSA). A fifth application, Visual Acquisition and Traffic Awareness, was tested in OpEval-1, but also was included in OpEval-2 to evaluate a specific procedure (see OpEval-1 Finalsummary). The visual acquisition application included the use of call sign in the traffic call-out to take advantage of the information available on the traffic display. The second objective was IO use these applications to evaluate ADS-B technololgy in a terminal area environment with air traffic controllers. The third objective was to highlight the safety and efficiency benefits of ADS-B by providing a limited demonstration to key industry participants, including labor, airline operations, general aviation, and the FAA. An important part of OpEval-2 was the collection and analysis of flightdeck observer data to aid in quantifying and verifying the expected benefits of CDTI. This report summarizes the development offlightdeck observer data forms and flight crew questionnaires, the training of flightdeck observers, and the collection and analysis of flightdeck observer data for OpEval-2. In addition, a summary of human factors issues related to CDTI is presented for each OpEval-2 application based on the results offlightdeck observer data analysis. Before these summaries are presented, a brief overview of OpEval-2 procedures and applications is given.
Author

Air Traffic Control; Display Devices; General Aviation Aircraft; Flight Safety

20030067974 Massachusetts Inst. of Tech., Cambridge, MA, USA

Modeling and Control of Airport Queueing Dynamics under Severe Flow Restrictions

Carr, Francis; Evans, Antony; Clarke, John-Paul; Deron, Eric; [2003]; 6 pp.; In English
Contract(s)/Grant(s): NCC2-1147; MIT-OSP Proj. 6890296; No Copyright; Avail: CASI; A02, Hardcopy

Based on field observations and interviews with controllers at BOS and EWR, we identify the closure of local departure fixes as the most severe class of airport departure restrictions. A set of simple queueing dynamics and traffic rules are developed to model departure traffic under such restrictions. The validity of the proposed model is tested via Monte Carlo simulation against 10 hours of actual operations data collected during a case-study at EWR on June 29,2000. In general, the model successfully reproduces the aggregate departure congestion. An analysis of the average error over 40 simulation runs indicates that flow-rate restrictions also significantly impact departure traffic; work is underway to capture these effects. Several applications and what-if scenarios are discussed for future evaluation using the calibrated model.
Author

Queueing Theory; Airports; Flow Distribution; Congestion

20030068010 Massachusetts Inst. of Tech., Cambridge, MA, USA

Runway Operations Planning: A Two-Stage Heuristic Algorithm

Anagnostakis, Ioannis; Clarke, John-Paul; AIAA Journal of Aircraft; [2003]; Volume 38, No. 6; 13 pp.; In English; AIAA Aircraft, Technology, Integration and Operations Forum, 1-3 Oct. 2002, Los Angeles, CA, USA

Contract(s)/Grant(s): NAG2-1128; Copyright; Avail: CASI; A03, Hardcopy

The airport runway is a scarce resource that must be shared by different runway operations (arrivals, departures and runway crossings). Given the possible sequences of runway events, careful Runway Operations Planning (ROP) is required if runway utilization is to be maximized. From the perspective of departures, ROP solutions are aircraft departure schedules developed by optimally allocating runway time for departures given the time required for arrivals and crossings. In addition to the obvious objective of maximizing throughput, other objectives, such as guaranteeing fairness and minimizing environmental impact, can also be incorporated into the ROP solution subject to constraints introduced by Air Traffic Control (ATC) procedures. This paper introduces a two stage heuristic algorithm for solving the Runway Operations Planning (ROP) problem. In the first stage, sequences of departure class slots and runway crossings slots are generated and ranked based on departure runway throughput under stochastic conditions. In the second stage, the departure class slots are populated with specific flights from the pool of available aircraft, by solving an integer program with a Branch & Bound algorithm implementation. Preliminary results from this implementation of the two-stage algorithm on real-world traffic data are presented.

Author

Air Traffic Control; Airports; Runways; Runway Conditions; Heuristic Methods; Algorithms

20030068097 NASA Glenn Research Center, Cleveland, OH, USA

Quantification of Ice Accretions for Icing Scaling Evaluations

Ruff, Gary A.; Anderson, David N.; July 2003; 20 pp.; In English; 36th Aerospace Sciences Meeting and Exhibit, 12-15 Jan. 2003, Reno, NV, USA

Contract(s)/Grant(s): WBS-22-708-20-18

Report No.(s): NASA/TM-2003-212308; NAS 1.15:212308; E-13891; AIAA Paper 98-0195; No Copyright; Avail: CASI; A03, Hardcopy

The comparison of ice accretion characteristics is an integral part of aircraft icing research. It is often necessary to compare an ice accretion obtained from a flight test or numerical simulation to one produced in an icing wind tunnel or for validation of an icing scaling method. Traditionally, this has been accomplished by overlaying two-dimensional tracings of ice accretion shapes. This paper addresses the basic question of how to compare ice accretions using more quantitative methods. For simplicity, geometric characteristics of the ice accretions are used for the comparison. One method evaluated is a direct comparison of the percent differences of the geometric measurements. The second method inputs these measurements into a fuzzy inference system to obtain a single measure of the goodness of the comparison. The procedures are demonstrated by comparing ice shapes obtained in the Icing Research Tunnel at NASA Glenn Research Center during recent icing scaling tests. The results demonstrate that this type of analysis is useful in quantifying the similarity of ice accretion shapes and that the procedures should be further developed by expanding the analysis to additional icing data sets.

Author

Aircraft Icing; Ice Formation

20030068297 Nebraska Univ., Omaha, NE, USA

The Airline Quality Rating 2003

Bowen, Brent D.; Headley, Dean E.; April 2003; 53 pp.; In English

Report No.(s): UNOAI-Rept-03-1; Copyright; Avail: CASI; A04, Hardcopy

The Airline Quality Rating (AQR) was developed and first announced in early 1991 as an objective method of comparing airline quality on combined multiple performance criteria. This current report, the Airline Quality Rating 2003, reflects monthly Airline Quality Rating scores for 2002. AQR scores for the calendar year 2002 are based on 15 elements that focus on airline performance areas important to air travel consumers. The Airline Quality Rating 2003 is a summary of month-by-month quality ratings for the 10 largest U.S. airlines operating during 2002. Using the Airline Quality Rating system of weighted averages and monthly performance data in the areas of ontime arrivals, involuntary denied boardings, mishandled baggage, and a combination of 12 customer complaint categories, airlines comparative performance for the calendar year of 2002 is reported. This research monograph contains a brief summary of the AQR methodology, detailed data and charts that track comparative quality for domestic airline operations for the 12-month period of 2002, and industry average results. Also,

comparative Airline Quality Rating data for 2001 are included for each airline to provide historical perspective regarding performance quality in the industry.
Author
Air Transportation; Airline Operations; Aircraft Industry; Civil Aviation

20030068344 NASA Dryden Flight Research Center, Edwards, CA, USA
Engine Damage to a NASA DC-8-72 Airplane From a High-Altitude Encounter With a Diffuse Volcanic Ash Cloud
Grindle, Thomas J.; Burcham, Frank W., Jr.; August 2003; 27 pp.; In English
Contract(s)/Grant(s): RTOP 436-14-01-E8-YY-00-DC8
Report No.(s): NASA/TM-2003-212030; NAS 1.15:212030; H-2511; No Copyright; Avail: CASI; A03, Hardcopy

The National Aeronautics and Space Administration (NASA) DC-8 airborne sciences research airplane inadvertently flew through a diffuse volcanic ash cloud of the Mt. Hekla volcano in February 2000 during a flight from Edwards Air Force Base (Edwards, California) to Kiruna, Sweden. Although the ash plume was not visible to the flight crew, sensitive research experiments and instruments detected it. In-flight performance checks and postflight visual inspections revealed no damage to the airplane or engine first-stage fan blades; subsequent detailed examination of the engines revealed clogged turbine cooling air passages. The engines were removed and overhauled. This paper presents volcanic ash plume analysis, trajectory from satellites, analysis of ash particles collected in cabin air heat exchanger filters and removed from the engines, and data from onboard instruments and engine conditions.
Author
Ashes; High Altitude; Plumes; Turbine Engines; Volcanoes; Dc 8 Aircraft; Damage

20030068346 Federal Aviation Administration, Atlantic City, NJ, USA
Menus and Mnemonics in Airway Facilities
Ahlstrom, V.; Muldoon, R.; Apr. 2003; 56 pp.
Report No.(s): PB2003-106637; DOT/FAA/CT-TN03/12; No Copyright; Avail: CASI; A04, Hardcopy

This study examines the use of menus and mnemonics in current Airway Facilities (AF) systems and compares them to human factors guidelines and best practices. Researchers from the William J. Hughes Technical Center traveled to AF field sites and collected data on the menus and mnemonics for the systems in use. The researchers extracted human factors guidance on menus and mnemonics from the literature and surveyed current commercial software. Using this information, they identified commercial standards for menu structure, terminology, mnemonics, options, and organization. They compared current AF systems against this information and developed recommendations for the design of future systems.
NTIS
Human Factors Engineering; Mnemonics

20030068348 Hughes Technical Center, Atlantic City International Airport, NJ, USA
Phoenix Sky Harbor International Airport, Airport Capacity Tactical Initiative, Ground Movement Analysis during Reconstruction of Runway 7L/25R
Holladay, R. J.; Renauro, G.; Feb. 2003; In English
Report No.(s): PB2003-106635; DOT/FAA/CT-TN03/8; No Copyright; Avail: National Technical Information Service (NTIS)

In August of 2002, the Office of System Capacity (ASC) was contacted to assist Phoenix Sky Harbor Air Traffic Control Tower (PHX-ATCT) in an evaluation of delay impacts caused by the reconstruction of Runway 7L/25R scheduled for January of 2003. The Office of System Capacity asked the Modeling and Analysis Group of the FAA Technical Center to apply their fast-time computer modeling techniques to analyze the ground movement implications of the reconstruction. The reconstruction of Runway 7L/25R is to be accomplished in several phases: Phase 1 was the preparation work for the reconstruction with the work being accomplished without major runway impacts; Phase 2 requires the complete closure of runway 7L/25R with only limited taxiways available for crossing the construction zone: Phase 3 occurs when a portion of Runway 7L/25R becomes available for aircraft use. This report addresses only Phase 2 - the complete closure of Runway 7L/25R.
NTIS
Runways; Airports; Construction

20030068476
Land and Hold Short Operations Risk Assessment, Final
Sep. 1999; 172 pp.
Report No.(s): PB2003-106658; No Copyright; Avail: CASI; A08, Hardcopy

More than 30 years ago, the FAA began allowing simultaneous operations on intersecting runways (SOIR) at certain U.S. airports under certain conditions. SOIR required a landing aircraft to stop before reaching an intersecting runway. In 1997, the concept was expanded to include hold short points before intersecting taxiways and at other points on the landing runway, under the designation of land and hold short operations (LAHSO). SOIR/LAHSO evolved from the observation that some landings did not require the full runway length and that this fact could be exploited to increase airport acceptance rates. Airports have been able to increase capacity without the need to physically expand the airport operating area. The objective of the analysis reported here is to answer several fundamental safety questions regarding land and hold short operations: What are the hazards associated with this operation; What are the existing controls for this procedure; Given the hazards and controls, what are the residual risks associated with this procedure; How can residual risks be reduced. It is also important to emphasize what this risk assessment does not do: This assessment does not judge the acceptability of LAHSO risks. This assessment does not reconcile differences in risk perceptions among participants.
NTIS
Risk; Aircraft Landing; Air Traffic Control; Hazards; Flight Safety; Airports

20030068936 Massachusetts Inst. of Tech., Cambridge, MA, USA
Runway Operations Planning and Control: Sequencing and Scheduling
Anagnostakis, Ioannis; Clarke, John-Paul; Boehme, Dietmar; Voelckers, Uwe; Journal of Aircraft; November-December 2001; Volume 38, No. 6, pp. 988-996; In English; 34th Hawaii International Conference on System Sciences, 3-6 Jan. 2001, Maui, HI, USA
Contract(s)/Grant(s): NCC2-1147; NAG2-1128; Copyright; Avail: Other Sources

The commercial aviation community has experienced a significant increase in the demand for air transportation over the past two decades. Despite the advent of new air traffic control (ATC) technologies, this increase in demand for air transportation has not been matched by an increase in capacity. Thus, because capacity/demand mismatches affect ATC airspace and ground operations, there has been a significant increase in delays during departure operations at major European and U.S. airports. The associated environmental impact and economic inefficiencies generate a growing need for the reduction of such delays. A framework and solution methodology developed at the Massachusetts Institute of Technology and the German Aerospace Research Establishment (DLR), to develop automated decision-aiding systems to assist air traffic controllers in handling departure traffic and mitigating the adverse effects of ground congestion and delays is presented. A possible formulation of the runway operations planning problem is presented with objectives and constraints.
Author
Air Traffic Control; Airports; Runways; Airline Operations; Automatic Control; Air Traffic Controllers (Personnel)

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*.

20030067884 NASA Langley Research Center, Hampton, VA, USA
Portable Wireless LAN Device and Two-way Radio Threat Assessment for Aircraft Navigation Radios
Nguyen, Truong X.; Koppen, Sandra V.; Ely, Jay J.; Williams, Reuben A.; Smith, Laura J.; Salud, Maria Theresa P.; July 2003; 227 pp.; In English
Contract(s)/Grant(s): DFTA03-96-X-90001; 728-30-10-03
Report No.(s): NASA/TP-2003-212438; L-18320; NAS 1.60:212438; No Copyright; Avail: CASI; A11, Hardcopy

Measurement processes, data and analysis are provided to address the concern for Wireless Local Area Network devices and two-way radios to cause electromagnetic interference to aircraft navigation radio systems. A radiated emission measurement process is developed and spurious radiated emissions from various devices are characterized using reverberation chambers. Spurious radiated emissions in aircraft radio frequency bands from several wireless network devices are compared with baseline emissions from standard computer laptops and personal digital assistants. In addition, spurious radiated emission data in aircraft radio frequency bands from seven pairs of two-way radios are provided, A description of the measurement process, device modes of operation and the measurement results are reported. Aircraft interference path loss measurements were conducted on four Boeing 747 and Boeing 737 aircraft for several aircraft radio systems. The measurement approach is described and the path loss results are compared with existing data from reference documents, standards, and NASA

partnerships. In-band on-channel interference thresholds are compiled from an existing reference document. Using these data, a risk assessment is provided for interference from wireless network devices and two-way radios to aircraft systems, including Localizer, Glideslope, Very High Frequency Omnidirectional Range, Microwave Landing System and Global Positioning System. The report compares the interference risks associated with emissions from wireless network devices and two-way radios against standard laptops and personal digital assistants. Existing receiver interference threshold references are identified as to require more data for better interference risk assessments.
Author
Electromagnetic Interference; Aircraft Communication; Microwave Landing Systems; Global Positioning System

20030067905 Tuskegee Inst., AL, USA
Effects of Self-Instructional Methods and Above Real Time Training (ARTT) for Maneuvering Tasks on a Flight Simulator
Ali, Syed Firasat; Khan, Javed Khan; Rossi, Marcia J.; Crane, Peter; Heath, Bruce E.; Knighten, Tremaine; Culpepper, Christi; August 2003; 30 pp.; In English
Contract(s)/Grant(s): NAG4-203; No Copyright; Avail: CASI; A03, Hardcopy

Personal computer based flight simulators are expanding opportunities for providing low-cost pilot training. One advantage of these devices is the opportunity to incorporate instructional features into training scenarios that might not be cost effective with earlier systems. Research was conducted to evaluate the utility of different instructional features using a coordinated level turn as an aircraft maneuvering task. In study I, a comparison was made between automated computer grades of performance with certified flight instructors grades. Every one of the six student volunteers conducted a flight with level turns at two different bank angles. The automated computer grades were based on prescribed tolerances on bank angle, airspeed and altitude. Two certified flight instructors independently examined the video tapes of heads up and instrument displays of the flights and graded them. The comparison of automated grades with the instructors grades was based on correlations between them. In study II, a 2x2 between subjects factorial design was used to devise and conduct an experiment. Comparison was made between real time training and above real time training and between feedback and no feedback in training. The performance measure to monitor progress in training was based on deviations in bank angle and altitude. The performance measure was developed after completion of the experiment including the training and test flights. It was not envisaged before the experiment. The experiment did not include self- instructions as it was originally planned, although feedback by experimenter to the trainee was included in the study.
Author
Personal Computers; Flight Simulators; Display Devices; Pilot Training

20030067956 Massachusetts Inst. of Tech., Cambridge, MA, USA
A Conceptual Design of a Departure Planner Decision Aid
Anagnostakis, Ioannis; Idris, Husni R.; Clark, John-Paul; Feron, Eric; Hansman, R. John; Odoni, Amedeo R.; Hall, William D.; AIAA Progress in Aeronautics and Astronautics; [2000]; Volume 193; 15 pp.; In English; 3rd USA/Europe Air Traffic Management R and D Seminar, 13-16 Jun. 2000, Napoli, Italy
Contract(s)/Grant(s): NAG2-1128; NCC2-1147; No Copyright; Avail: CASI; A03, Hardcopy

Terminal area Air Traffic Management handles both arriving and departing traffic. To date, research work on terminal area operations has focused primarily on the arrival flow and typically departures are taken into account only in an approximate manner. However, arrivals and departures are highly coupled processes especially in the terminal airspace, with complex interactions and sharing of the same airport resources between arrivals and departures taking place in practically every important terminal area. Therefore, the addition of automation aids for departures, possibly in co-operation with existing arrival flow automation systems, could have a profound contribution in enhancing the overall efficiency of airport operations. This paper presents the conceptual system architecture for such an automation aid, the Departure Planner (DP). This architecture can be used as a core in the development of decision-aiding systems to assist air traffic controllers in improving the performance of departure operations and optimize runway time allocation among different operations at major congested airports. The design of such systems is expected to increase the overall efficiency of terminal area operations and yield benefits for all stakeholders involved in Air Traffic Management (ATM) operations, users as well as service providers.
Author
Airports; Decision Support Systems; Air Traffic Control; Air Traffic Controllers (Personnel)

20030067994 Massachusetts Inst. of Tech., Cambridge, MA, USA

Input-Output Modeling and Control of the Departure Process of Congested Airports

Pujet, Nicolas; Delcaire, Bertrand; Feron, Eric; September 2003; 18 pp.; In English

Contract(s)/Grant(s): NCC2-1147; NAG2-1128; Copyright; Avail: CASI; A03, Hardcopy

A simple queueing model of busy airport departure operations is proposed. This model is calibrated and validated using available runway configuration and traffic data. The model is then used to evaluate preliminary control schemes aimed at alleviating departure traffic congestion on the airport surface. The potential impact of these control strategies on direct operating costs, environmental costs and overall delay is quantified and discussed.

Author

Operating Costs; Airports; Runways; Congestion

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*.

20030067699 NASA Dryden Flight Research Center, Edwards, CA, USA

Load Pad Development for Research Aircraft Wing Strain Gage Loads Calibration Test

Crawford, Natalie D.; March 2002; 5 pp.; In English; SEM (Society of Experimental Mechanics) Annual Conference, 10-12 Jun. 2002, Milwaukee, WI, USA; Original contains black and white illustrations

Contract(s)/Grant(s): WU 706-35-00-E8-14

Report No.(s): H-2477; No Copyright; Avail: CASI; A01, Hardcopy

An elastomeric tension-compression load pad material was selected in preparation for ground loads testing of a research aircraft. Five rubber materials candidates were load tested for ultimate tensile strength, creep strength, low-cycle fatigue strength, and compressive stiffness. Additionally, two bonding agents candidates were tested for strength properties, ease of application, removal, and reliability. Material testing was completed at NASA Dryden Flight Research Center to select a load pad material and a bonding agent capable of providing the elastomer interface for the aircraft while enduring both tensile and compressive applied loads.

Author

Calibrating; Compression Loads; Elastomers; Research Aircraft; Strain Gages; Aeroelastic Research Wings; Mechanical Properties

20030067717 NASA Marshall Space Flight Center, Huntsville, AL, USA

Altitude Compensating Nozzle Cold Flow Test Results

Ruf, J. H.; McDaniels, D. M.; [2002]; 1 pp.; In English; 39th AIAA/ASME/SAE/ASEE Joint Propulsion Conference and Exhibit, 20-23 Jul. 2003, Huntsville, AL, USA; No Copyright; Avail: CASI; A01, Hardcopy

A suite of four altitude compensating nozzle (ACN) concepts were evaluated by NASA MSFC in the Nozzle Test Facility. The ACN concepts were a dual bell, a dual expander, an annular plug nozzle and an expansion deflection nozzle. Two reference bell nozzles were also tested. Axial thrust and nozzle wall static pressures were measured for each nozzle over a wide range of nozzle pressure ratios. The nozzle hardware and test program are described. Sample test results are presented.

Author

Cold Flow Tests; Nozzle Geometry; Altitude; Test Facilities

20030067723 Howell Instruments, Inc., Fort Worth, TX

JETCAL 2000R Analyzer H337PA-603 Operational Test and Evaluation (OT&E) on H-53 E/J Aircraft and H46 D/E Aircraft

Pettigrew, James L.; Jan. 28, 2003; 79 pp.; In English; Original contains color illustrations

Report No.(s): AD-A414712; M67854-97-C-2117; No Copyright; Avail: CASI; A05, Hardcopy

Howell Instruments Inc is pleased to provide the JETCAL2000 Analyzer that implements a turn-key portable test set solution for testing installed turbine engines in H-46D/E and H-53E/J aircraft. This portable test set proposal takes an innovative approach to providing a cost-effective solution for lowering Operations and Support (O&S) costs, Howell Instruments, Inc, is a well-respected engine instrumentation company with over 52 years experience of design and

manufacture of commercial and military systems Howell developed the JETCAL2000(trademark) Analyzer prototype in 1991 for Gulfstream aircraft. Other versions of the JETCAL2OOO(trademark) Analyzer demonstrated their value when used by numerous airlines on their SAAB 340 and CN 235 fleets to determine pre-and post-maintenance status and temperature margin on CT7 series engines. The JETCAL2OOO Analyzer continues to prove its benefits in various military and commercial applications while undergoing timely upgrades to maintain its state-of-the-art technology. The leverage of adapting this developed, commercial technology to Army helicopters will prove beneficial to the government.
DTIC
H-53 Helicopter; Turbine Engines

20030067742 Air Force Research Lab., Wright-Patterson AFB, OH
Joint Strike Fighter Integrated Subsystem Technology (J/IST) Demonstration Program. Execution and Management of a Technology Maturation Program Conducted by Industry, for Industry
Burkhard, Alan; Deitrich, Richard; Apr. 2003; 18 pp.; In English
Report No.(s): AD-A414734; AFRL-VA-WP-TP-2003-307; No Copyright; Avail: CASI; A03, Hardcopy

The Joint Strike Fighter (JSF) Integrated Subsystems Technology (J/IST) demonstration Program was a highly successful industry- wide five-year program in which normally competitive JSF Weapon System Contractors (WSCs) and suppliers worked together with competitors to accomplish technology maturation and mitigate technological risks of a revolutionary subsystem concept for tactical aircraft that integrates the subsystems and utility functions thereby reducing the associated major equipment groups from 13 to 5.
DTIC
Weapon Systems; Management Systems

20030067828 Army Aeromedical Research Lab., Fort Rucker, AL
The Role of the Pilots Night Vision System (PNVS) and Integrated Helmet and Display Sighting System (IHADSS) in AH-64 Apache Accidents
Rash, C. E.; Reynolds, B. S.; Stelle, J. A.; Peterson, R. D.; Leduc, P. A.; Apr. 2003; 32 pp.; In English
Report No.(s): AD-A414806; USAARL-2003-08; No Copyright; Avail: CASI; A03, Hardcopy

Helmet-mounted displays (HMDs), while not new, are a unique method of providing pilotage and targeting imagery to aviators. Although there are a number of HMDs in various phases of design, the AH-64s Integrated Helmet and Display Sighting System (IHADSS) is currently the Army's only fielded integrated HMD. A number of studies have investigated the visual and perceptual issues associated with the monocular optical design of the IHADSS in combination with the AH-64s forward looking infrared (FLIP) thermal sensor (Pilots Night Vision System - PNVS). While these systems have greatly enhanced the operational effectiveness of the AH-64, they have resulted in reports of physiological complaints, degraded visual cues and both static and dynamic illusions. This study investigated the possible role the IHADSS MMD and PNVS may have played in AH-64 Apache accidents. A total of 217 AH-64 accidents (FY85-02) were analyzed and assigned causal factors associated with the use of the IHADSS and PNVS. The resulting analysis failed to identify any significant role between these systems and flight-related accidents.
DTIC
Optical Properties; Ah-64 Helicopter; Display Devices; Night Vision

20030067900 NASA Ames Research Center, Moffett Field, CA, USA
American Helicopter Society Test and Evaluation Technical Committee Report
Jacklin, Stephen A.; Hindson, William; Kelly, Henry; Goldenberg, Joaquem; Ayer, John; Hermans, Christopher; Hardesty, Mark; Gmelin, Bernd; Peterson, Allen; Barker, Bil, et al.; [1999]; 2 pp.; In English; Copyright; Avail: Other Sources

The AHS technical committee for Test and Evaluation is comprised of representatives from industry and government rotorcraft technology development centers. The committee considers many aspects of rotorcraft and VTOL testing, including the evaluation of components and subsystems. In addition, the committee seeks to evaluate the effectiveness of new procedures and operational solutions to problems that are encountered in the low-speed flight regime for both land and ship-based environments. This article presents the test and evaluation committee highlights for 98-99. Though by no means comprehensive, the article includes significant efforts related to test and evaluation contributed by the committee members for their respective organizations.
Author
Flight Tests; Vertical Flight; Bell Aircraft; Rotary Wing Aircraft

20030067961 Honeywell Engines, Systems and Services, Phoenix, AZ, USA

Design and Test of Fan/Nacelle Models Quiet High-Speed Fan Design

Miller, Christopher J., Technical Monitor; Repp, Russ; Gentile, David; Hanson, David; Chunduru, Srinivas; July 2003; 244 pp.; In English; Original contains color and black and white illustrations

Contract(s)/Grant(s): NAS3-27752; WU 781-30-11

Report No.(s): NASA/CR-2003-212369; E-13945; NAS 1.26:212369; No Copyright; Avail: CASI; A11, Hardcopy

The primary objective of the Quiet High-Speed Fan (QHSF) program was to develop an advanced high-speed fan design that will achieve a 6 dB reduction in overall fan noise over a baseline configuration while maintaining similar performance. The program applies and validates acoustic, aerodynamic, aeroelastic, and mechanical design tools developed by NASA, US industry, and academia. The successful fan design will be used in an AlliedSignal Engines (AE) advanced regional engine to be marketed in the year 2000 and beyond. This technology is needed to maintain US industry leadership in the regional turbofan engine market.

Author

Design Analysis; Performance Tests; High Speed; Turbofan Engines

20030067984 NASA Glenn Research Center, Cleveland, OH, USA

Application of a Bank of Kalman Filters for Aircraft Engine Fault Diagnostics

Kobayashi, Takahisa; Simon, Donald L.; August 2003; 15 pp.; In English; Turbo Expo 2003, 16-19 Jun. 2003, Atlanta, GA, USA

Contract(s)/Grant(s): WBS 22-728-30-20; DA Proj. 1L1-61102-AF-20

Report No.(s): NASA/TM-2003-212526; E-14088; NAS 1.15:212526; ARL-TR-2955; GT2003-38550; No Copyright; Avail: CASI; A03, Hardcopy

In this paper, a bank of Kalman filters is applied to aircraft gas turbine engine sensor and actuator fault detection and isolation (FDI) in conjunction with the detection of component faults. This approach uses multiple Kalman filters, each of which is designed for detecting a specific sensor or actuator fault. In the event that a fault does occur, all filters except the one using the correct hypothesis will produce large estimation errors, thereby isolating the specific fault. In the meantime, a set of parameters that indicate engine component performance is estimated for the detection of abrupt degradation. The proposed FDI approach is applied to a nonlinear engine simulation at nominal and aged conditions, and the evaluation results for various engine faults at cruise operating conditions are given. The ability of the proposed approach to reliably detect and isolate sensor and actuator faults is demonstrated.

Author

Kalman Filters; Aircraft Engines; Diagnosis; Gas Turbine Engines; Actuators; Fault Detection

20030068096 Air Force Academy, CO

Impact of Parameter Accuracy on Aircraft Structural Integrity Estimates

Fawaz, Scott A.; Harter, James A.; Jul. 2001; 177 pp.; In English; Original contains color illustrations

Report No.(s): AD-A415170; AFRL-VA-WP-TR-2001-3057; No Copyright; Avail: CASI; A09, Hardcopy

This report docments work performed to quantify the effect of various Linear Elastic Fracture Mechanics (LEFM) parameters and material properties on the life of aircraft structures. Automated computer methods were used to perform life comparisons using the Air Force crack growth life prediction software, AFGROW.

DTIC

Fracture Mechanics; Life (Durability); Aircraft Structures; Automatic Control

20030068104 NASA Glenn Research Center, Cleveland, OH, USA

Control of Thermo-Acoustics Instabilities: The Multi-Scale Extended Kalman Approach

Le, Dzu K.; DeLaat, John C.; Chang, Clarence T.; August 2003; 16 pp.; In English; 39th Joint Propulsion Conference and Exhibit, 20-23 Jul. 2003, Huntsville, AL, USA

Contract(s)/Grant(s): WBS-22-708-28-09

Report No.(s): NASA/TM-2003-212536; E-14100; NAS 1.15:212536; AIAA Paper 2003-4934; No Copyright; Avail: CASI; A03, Hardcopy

'Multi-Scale Extended Kalman' (MSEK) is a novel model-based control approach recently found to be effective for suppressing combustion instabilities in gas turbines. A control law formulated in this approach for fuel modulation demonstrated steady suppression of a high-frequency combustion instability (less than 500Hz) in a liquid-fuel combustion test

rig under engine-realistic conditions. To make-up for severe transport-delays on control effect, the MSEK controller combines a wavelet -like Multi-Scale analysis and an Extended Kalman Observer to predict the thermo-acoustic states of combustion pressure perturbations. The commanded fuel modulation is composed of a damper action based on the predicted states, and a tones suppression action based on the Multi-Scale estimation of thermal excitations and other transient disturbances. The controller performs automatic adjustments of the gain and phase of these actions to minimize the Time-Scale Averaged Variances of the pressures inside the combustion zone and upstream of the injector. The successful demonstration of Active Combustion Control with this MSEK controller completed an important NASA milestone for the current research in advanced combustion technologies.
Author
Active Control; Thermoacoustic Effects; Kalman Filters; Combustion Stability; Combustion Control

20030068110 National Advisory Committee for Aeronautics. Langley Aeronautical Lab., Langley Field, VA, USA
Flight Measurements of Average Skin-Friction Coefficients on a Parabolic Body of Revolution (NACA RM-10) at Mach Numbers from 1.0 to 3.7
Loposer, J. Dan; Rumsey, Charles B.; August 25, 1954; 33 pp.; In English; Original contains black and white illustrations
Report No.(s): NACA-RM-L54G14; No Copyright; Avail: CASI; A03, Hardcopy

Measurement of average skin-friction coefficients have been made on six rocket-powered free-flight models by using the boundary-layer rake technique. The model configuration was the NACA RM-10, a 12.2-fineness-ratio parabolic body of revolution with a flat base. Measurements were made over a Mach number range from 1 to 3.7, a Reynolds number range 40 x 10(exp 6) to 170 x 10(exp 6) based on length to the measurement station, and with aerodynamic heating conditions varying from strong skin heating to strong skin cooling. The measurements show the same trends over the test ranges as Van Driest's theory for turbulent boundary layer on a flat plate. The measured values are approximately 7 percent higher than the values of the flat-plate theory. A comparison which takes into account the differences in Reynolds number is made between the present results and skin-friction measurements obtained on NACA RM-10 scale models in the Langley 4- by 4-foot supersonic pressure tunnel, the Lewis 8- by 6-foot supersonic tunnel, and the Langley 9-inch supersonic tunnel. Good agreement is shown at all but the lowest tunnel Reynolds number conditions. A simple empirical equation is developed which represents the measurements over the range of the tests.
Author
In-Flight Monitoring; Skin Friction; Parabolic Bodies; Bodies Of Revolution; Coefficients

20030068355 Aerospace Industries Association of America, Inc., Washington, DC, USA
Commission on the Future of the USA Aerospace Industry
Nov. 2002; In English
Report No.(s): PB2003-106645; No Copyright; Avail: National Technical Information Service (NTIS)

This nation needs a national vision to keep alive the flames of imagination and innovation that have always been a hallmark of aerospace. For inspiration, we looked to what aerospace can do for our nation and world. The vision the Commission used to guide its efforts is 'Anyone, Anything, Anywhere, Anytime.' We offer this to the nation as its vision for aerospace. To achieve our vision for aerospace, the Commission concludes that: the nation needs a national aerospace policy; there needs to be a government-wide framework that implements this policy; the Administration and Congress need to remove prohibitive legal and regulatory barriers that impede this sectors growth and continually seek to level the international playing field; and global U.S. aerospace leadership can only be achieved through investments in our future, including our industrial base, workforce, longterm research and national infrastructure.
NTIS
Aerospace Industry; United States

20030068393
Aviation Safety Statistical Handbook, 1999 Annual Report
2000; 88 pp.
Report No.(s): PB2003-106647; No Copyright; Avail: CASI; A05, Hardcopy

This handbook contains aviation safety statistical information in tabular and graphical format for national airspace incidents and aircraft accidents. Data are presented for Near Midair Collisions (NMACs), Operational Errors (OEs), Operational Deviations (ODs), Pilot Deviations (PDs), Vehicle/Pedestrian Deviations (VPDs), Surface Incidents (SIs),

Runway Incursions (RIs), Flight Assist, and aircraft accidents. Data are predominantly presented for the years 1994 through 1999.
NTIS
Aircraft Safety; Flight Safety; Handbooks

20030068395 Federal Aviation Administration, Atlantic City, NJ, USA
Description and Analysis of the FAA Onboard Oxygen Analysis System
Burns, M.; Cavage, W. M.; Jul. 2003; In English
Report No.(s): PB2003-106633; No Copyright; Avail: National Technical Information Service (NTIS)

The Federal Aviation Administration (FAA) is planning a series of ground and flight tests with Airbus to prove the concept of a simplified fuel tank inerting system, which has been developed by the FAA. The FAA has also developed an onboard oxygen analysis system to measure the oxygen concentration in the aircraft fuel tank during the testing. To help ensure smooth integration and the safety of the testing, the FAA has documented the system description, interfaces, operation, and has performed a failure mode effects criticality analysis. This analysis attempts to identify the failure modes of each system component and assess the effects of these failures on the component, system, and aircraft. The analysis also applies a hazard category to each hazard as well as some hazard probability when it was deemed necessary by the author. Hazard controls are also listed. All relevant system information has been summarized to allow for the system to be properly integrated into the proposed flight test aircraft. The results of the analysis indicated that most failure modes had no effect on the aircraft or other secondary systems. The few hazards with potential aircraft effects have significant controls in place to reduce the likelihood of the hazard and mitigate any potential hazard exposure.
NTIS
Fuel Tanks; Ground Tests; Flight Tests

20030068519 Research Inst. for Advanced Computer Science, Moffett Field, CA, USA
[Activities of Research Institute for Advanced Computer Science]
Gross, Anthony R., Technical Monitor; Leiner, Barry M.; December 2001; 162 pp.; In English; Original contains black and white illustrations
Contract(s)/Grant(s): NCC2-1006
Report No.(s): RIACS-TR-AR-01; Copyright; Avail: CASI; A08, Hardcopy

The Research Institute for Advanced Computer Science (RIACS) carries out basic research and technology development in computer science, in support of the National Aeronautics and Space Administrations missions. RIACS is located at the NASA Ames Research Center, Moffett Field, California. RIACS research focuses on the three cornerstones of IT research necessary to meet the future challenges of NASA missions: 1. Automated Reasoning for Autonomous Systems Techniques are being developed enabling spacecraft that will be self-guiding and self-correcting to the extent that they will require little or no human intervention. Such craft will be equipped to independently solve problems as they arise, and fulfill their missions with minimum direction from Earth. 2. Human-Centered Computing Many NASA missions require synergy between humans and computers, with sophisticated computational aids amplifying human cognitive and perceptual abilities. 3. High Performance Computing and Networking Advances in the performance of computing and networking continue to have major impact on a variety of NASA endeavors, ranging from modeling and simulation to analysis of large scientific datasets to collaborative engineering, planning and execution. In addition, RIACS collaborates with NASA scientists to apply IT research to a variety of NASA application domains. RIACS also engages in other activities, such as workshops, seminars, visiting scientist programs and student summer programs, designed to encourage and facilitate collaboration between the university and NASA IT research communities.
Derived from text
Automatic Control; Networks; Human-Computer Interface

20030068710 Defence Science and Technology Organisation, Fishermans Bend, Australia
DEF STAN 00-970 Requirements for the Design and Airworthiness of Composite Aircraft Structure
Callus, Paul J.; June 2003; 100 pp.; In English
Report No.(s): DSTO-TN-0498; DODA-AR-012-787; Copyright; Avail: Other Sources

The Australian Defence Force (ADF) maintains a keen interest in the application of composite materials to aircraft structures. The reduced weight and improved resistance to fatigue and corrosion degradation offer the potential to improve aircraft performance while reducing through-life-support costs. Many current aircraft contain signrficant quantities of

monolithic and bonded composite material. This appears likely to increase in future acquisitions. In addition the ADF has a long history of using bonded composite repairs to support its fleet. Despite this background, virtually all of the composite structure within ADF aircraft, particularly primary structure, has been certified outside of Australia. One reason for this is the difficulty in idenbfying the specific set of airworthiness design requirements against which the composite structure will be certified. Currently there is no documentation that does this. The ADF airworthiness policy (Australian Air Publication 7001.054 [l]) states that contractors should submit their proposed certification basis and this will be assessed by the Commonwealth against a comparative basis. The ADF comparative basis is the UK Ministry of Defence s DEF STAN 00-970 [2], supplemented with AAP 7001.054 to account for specific ADF requirements. These documents focus on traditional metallic aircraft structure, so their layout and treatment of issues is not optimised for composites. DEF STAN 00-970 and AAP 7001.054 were reviewed and, in this report, the requirements and guidance considered relevant to composite structure are collated and re-arranged into a more logical format for composites. This is the first time that the airworthiness requirements relevant to composite structure have been identified and extracted from the ADF comparative airworthiness standards. The certification requirements for any specific composite part must be developed on a case-by-case basis. The requirements identified in this report cover all possible composite structures, from a non-structural part to an entire aircraft. The requirements for any specific part will likely form a sub-set of these.

Author

Australia; Composite Materials; Aircraft Reliability; Aircraft Design

20030068764 Defence Science and Technology Organisation, Fishermans Bend, Australia

Vertical Tail Dynamic Response in Vortex Breakdown Flow

Levinski, Oleg; June 2003; 87 pp.; In English

Report No.(s): DSTO-RR-0256; DODA-AR-012-790; Copyright; Avail: Other Sources

The airframes of high performance aircraft, such as the F/A-18, have suffered from an aeroelastic tail buffet problem for many years. This problem is inherent to vortical flows used to generate lift at high angles of attack as they tend to break down causing severe empennage dynamic loading and premature fatigue failures. Better understanding of the empennage buffeting problem is required for development of reliable fatigue usage monitoring systems and for the fleet management of aircraft. The challenges associated with computational simulation of empennage buffet vary from prediction of the nonlinear separated vortical flows about complex configurations to the coupled interaction between the flow and the dynamic response of the tail structure. The work describes the development and validation of an aeroelastic model for the prediction of the F/ A-18 empennage buffet due to bursting LEX vortices under various flight conditions. The multidisciplinary problem of tail buffeting is solved accurately in the time domain using an unsteady vortex model for prediction of aerodynamic loads and coupled aeroelastic equations for the bending and torsional deflections of the tail which are resolved using the Galerkin method. A dynamic aeroelastic analysis of empennage buffet is performed for a generic delta wing, twin vertical-tail configuration at high angles of attack. Results of flow simulation indicated that the aeroelastic model is able to predict major unsteady features of the vortex induced buffet loads and the resulting coupled fluid-structure interaction. The present research provides advances in the predictive capability and our understanding of aircraft empennage buffet. Results of the work contribute to DSTOs existing body of knowledge on vortex breakdown and can be used in assessing the buffet environments of current and future generations of fighter aircraft.

Author

Aeroelasticity; Buffeting; Aerodynamic Loads; Fighter Aircraft

20030068802 Defence Science and Technology Organisation, Fishermans Bend, Australia

Ex-Service F/A-18 Centre Barrel Fatigue Flaw Identification Test Plan

Dixon, B.; Molent, L.; May 2003; 26 pp.; In English

Report No.(s): DSTO-TR-1426; DODA-AR-012-757; Copyright; Avail: Other Sources

This report provides a generic plan for fatigue cycling and teardown of ex-service F/A-18 center barrels for the purpose of fatigue flaw identification. It describes the accelerated fatigue test cycling program which will be applied to each center barrel to increase the size of existing microflaws or defects so that they can be more reliably detected. It also covers the teardown, inspection and storage requirements of the project.

Author

F-18 Aircraft; Fatigue Tests; Fuselages; Fatigue (Materials); Microcracks; Accelerated Life Tests; Defects

20030068933 Army Research Lab., Hampton, VA, USA

Water Impact Test and Simulation of a Composite Energy Absorbing Fuselage Section

Fasanella, Edwin L.; Jackson, Karen E.; Sparks, Chad; Sareen, Ashish; [2003]; 20 pp.; In English; AHS 59th Annual Forum, 6-8 May 2003, Phoenix, AZ, USA; No Copyright; Avail: CASI; A03, Hardcopy

In March 2002, a 25-ft/s vertical drop test of a composite fuselage section was conducted onto water. The purpose of the test was to obtain experimental data characterizing the structural response of the fuselage section during water impact for comparison with two previous drop tests that were performed onto a rigid surface and soft soil. For the drop test, the fuselage section was configured with ten 100-lb. lead masses, five per side, that were attached to seat rails mounted to the floor. The fuselage section was raised to a height of 10-ft. and dropped vertically into a 15-ft. diameter pool filled to a depth of 3.5-ft. with water. Approximately 70 channels of data were collected during the drop test at a 10-kHz sampling rate. The test data were used to validate crash simulations of the water impact that were developed using the nonlinear, explicit transient dynamic codes, MSC.Dytran and LS-DYNA. The fuselage structure was modeled using shell and solid elements with a Lagrangian mesh, and the water was modeled with both Eulerian and Lagrangian techniques. The fluid-structure interactions were executed using the fast general coupling in MSC.Dytran and the Arbitrary Lagrange-Euler (ALE) coupling in LS-DYNA. Additionally, the smooth particle hydrodynamics (SPH) meshless Lagrangian technique was used in LS-DYNA to represent the fluid. The simulation results were correlated with the test data to validate the modeling approach. Additional simulation studies were performed to determine how changes in mesh density, mesh uniformity, fluid viscosity, and failure strain influence the test-analysis correlation.

Author

Drop Tests; Failure; Fuselages; Hydrodynamics; Impact Tests; Water

06
AVIONICS AND AIRCRAFT INSTRUMENTATION

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

20030067892 bd Systems, Inc., Huntsville, AL, USA

Avionics GPB Control System Analysis

February 14, 2003; 119 pp.; In English

Contract(s)/Grant(s): NAS8-00114; NASA Order H-32846-D

Report No.(s): TCD20030028A; No Copyright; Avail: CASI; A06, Hardcopy

Gravity Probe B is a Satellite being developed by Lockheed Martin under NASA contract through MSFC and managed by Stanford University. The goal of the satellite experiment is to test the accuracy of drift predictions made using Einstein s General Theory of Relativity. The drift in the direction of the spin axes of 4 highly precise quartz spherical gyroscopes induced by motion in the earth s gravitational field will be measured over a year s duration with the known, non-relativistic effects removed. The expected angles of drift for a one year period are approximately 6.6 arcsec for drift in the orbit plane called geodetic drift and 0.033 arcsec of drift normal to the orbit plane called frame dragging. The aerodynamic drag force on the GPB Satellite is compensated by a translation control system. It is pointed at a guide star and maintained in spin at a rate to be selected in the range 0.1 - 1 rpm. The purpose of our task is to update the TREETOPS GPB spacecraft simulation and to assist MSFC in assessing the affect of Helium slosh dynamics on spacecraft pointing performance.

Derived from text

Geodesy; Gravity Probe B; Relativity; Avionics; Control Systems Design; Relativistic Effects

20030068293 NASA Glenn Research Center, Cleveland, OH, USA

Aircraft Turbofan Engine Health Estimation Using Constrained Kalman Filtering

Simon, Dan; Simon, Donald L.; August 2003; 13 pp.; In English; Turbo Expo 2003, 16-19 Jun. 2003, Atlanta, GA, USA

Contract(s)/Grant(s): WBS-22-728-30-20; DA Proj. 1L1-61102-AF-20

Report No.(s): NASA/TM-2003-212528; ARL-TR-2956; GT2003-38584; E-14090; NAS 1.15:212528; No Copyright; Avail: CASI; A03, Hardcopy

Kalman filters are often used to estimate the state variables of a dynamic system. However, in the application of Kalman filters some known signal information is often either ignored or dealt with heuristically. For instance, state variable constraints (which may be based on physical considerations) are often neglected because they do not fit easily into the structure of the

Kalman filter. This paper develops an analytic method of incorporating state variable inequality constraints in the Kalman filter. The resultant filter is a combination of a standard Kalman filter and a quadratic programming problem. The incorporation of state variable constraints increases the computational effort of the filter but significantly improves its estimation accuracy. The improvement is proven theoretically and shown via simulation results obtained from application to a turbofan engine model. This model contains 16 state variables, 12 measurements, and 8 component health parameters. It is shown that the new algorithms provide improved performance in this example over unconstrained Kalman filtering.
Author
Turbofan Engines; Quadratic Programming; Inequalities; Algorithms

20030068471
Global Aviation Information Network (GAIN): Using Information Proactively to Improve Aviation Safety
Feb. 2002; 20 pp.
Report No.(s): PB2003-106654; No Copyright; Avail: CASI; A03, Hardcopy

The Federal Aviation Administration (FAA) proposed the Global Aviation Information Network (GAIN) as a voluntary, privately owned and operated network of systems that collect and use aviation safety information about flight operations, air traffic control operations, and maintenance to improve aviation safety worldwide. The necessity for better ways to improve safety is revealed by the worldwide aviation accident rate--after enjoying a decline to a commendably low rate, it has been stubbornly constant for the last 10-15 years, and the aviation community must determine how to get off this plateau.
NTIS
Flight Safety; Aircraft Communication; Air Traffic Control; Information Systems

20030068521 Defence Science and Technology Organisation, Fishermans Bend, Australia
Low Airspeed Measuring Devices for Helicopter Usage Monitoring Systems
Knight, C. G.; May 2003; 35 pp.; In English
Report No.(s): DSTO-TN-0495; DODA-AR-012-765; Copyright; Avail: Other Sources

A helicopter manufacturer usually specifies the retirement structural components based on assumed usage spectra. lives of fatigue life-limited This is dependent on the aircraft s mission profile and measured flight loads. A more accurate method measures the actual, in-service, usage. This method, Usage Monitoring, aims to identdy how the helicopter is being used and then estimates how much fatigue life remains for specific components before they need to be replaced. One of the key parameters for Usage Monitoring is the helicopter s airspeed. Unfortunately traditional methods of measuring airspeed, such as the Pitot-static system, often do not work below 30-45 kt. As some low speed manoeuvres, such as hover, sideward and rearward flight, do significant damage to components in terms of fatigue life accrual, it is important that low airspeed be measured accurately. No current Australian Defence Force (ADF) helicopters have low airspeed indicators. However, low airspeed measurement is critical on attack helicopters, due to the low speed targeting requirements. The ADF is about to start operating an attack helicopter, the Eurocopter Tiger. Thus knowledge of low airspeed methodologies will also aid in the introduction to service of this new platform. This report outlines some potential methods for measuring low helicopter airspeeds, where the normal airspeed sensing system does not work adequately. In addition to a review of available methods, some additional work in this area was completed as part of a proof-of-concept demonstrator. A simple variable incidence anemometer was designed and tested in the low airspeed wind tunnel at the Platform Sciences Laboratory.
Author
Military Helicopters; Airspeed

07
AIRCRAFT PROPULSION AND POWER

Includes primary propulsion systems and related systems and components, e.g., gas turbine engines, compressors, and fuel systems; 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*.

20030067710 NASA Glenn Research Center, Cleveland, OH, USA

Design and Fabrication of High-Temperature, Radial Magnetic Bearing for Turbomachinery

Corrigan, Robert, Technical Monitor; Montague, Gerald; Jansen, Mark; Ebihara, Ben; Jansen, Ralph; Palazzolo, Alan; Tucker, Randy; Preuss, Jason; Hunt, Andrew; Trudell, Jeff; July 2003; 18 pp.; In English; Original contains color and black and white illustrations

Contract(s)/Grant(s): WBS 22-708-28-12; DA Proj. 1L1-61102-AF-20

Report No.(s): NASA/TM-2003-212300; E-13861; NAS 1.15:212300; ARL-TR-2954; No Copyright; Avail: CASI; A03, Hardcopy

Motors, magnetic bearings, and other electromagnetic actuators that can operate at 1000 F (540 C) hold great promise for providing increased efficiency in machinery for many applications ranging from pebble-bed nuclear reactors and chemical processing to aircraft and unmanned aerial combat vehicle (UCAV) propulsion systems. This report discusses in detail the design and fabrication of a high-temperature, heteropolar, radial magnetic bearing that was operated at 1000 F (540 C). The development of high-temperature wire and a coil fabrication process are two significant technical barriers overcome by the Army Research Laboratory (ARL), the NASA Glenn Research Center, and the Texas A&M University (TAMU) team. This is ARL/NASA/TAMU s third-generation high-temperature magnetic bearing. The motivation for this research came from the pursuit of a more electric gas turbine engine and a high-temperature, large-diameter, 4-million-DN (diam in millimeters times rotor speed in revolutions per minute) rotor support system.

Author

Magnetic Bearings; Turbomachinery; Dielectrics; Insulation; Fabrication; High Temperature

20030067846 NASA Glenn Research Center, Cleveland, OH, USA

Strength, Fracture Toughness, Fatigue, and Standardization Issues of Free-Standing Thermal Barrier Coatings

Choi, Sung R.; Zhu, Dong-Ming; Miller, Robert A.; July 2003; 23 pp.; In English; 27th Annual Cocoa Beach Conference and Exposition on Advanced Ceramics and Composites, 26-31 Jan. 2003, Cocoa Beach, FL, USA; Original contains color illustrations

Contract(s)/Grant(s): WBS 22-714-04-05

Report No.(s): NASA/TM-2003-212516; E-14076; NAS 1.15:212516; Paper ECD-S2-14-2003; No Copyright; Avail: CASI; A03, Hardcopy

Strength, fracture toughness and fatigue behavior of free-standing thick thermal barrier coatings of plasma-sprayed ZrO2-8wt % Y2O3 were determined at ambient and elevated temperatures in an attempt to establish a database for design. Strength, in conjunction with deformation (stress-strain behavior), was evaluated in tension (uniaxial and trans-thickness), compression, and uniaxial and biaxial flexure; fracture toughness was determined in various load conditions including mode I, mode II, and mixed modes I and II; fatigue or slow crack growth behavior was estimated in cyclic tension and dynamic flexure loading. Effect of sintering was quantified through approaches using strength, fracture toughness, and modulus (constitutive relations) measurements. Standardization issues on test methodology also was presented with a special regard to material's unique constitutive relations.

Author

Thermal Control Coatings; Fracture Strength; Fatigue (Materials); Deformation

20030067946 United Technologies Corp., West Palm Beach, FL, USA

Follow-On Technology Requirement Study for Advanced Subsonic Transport

Wendus, Bruce E.; Stark, Donald F.; Holler, Richard P.; Funkhouser, Merle E.; August 2003; 58 pp.; In English

Contract(s)/Grant(s): NAS3-26618; WU-538-06-11-00

Report No.(s): NASA/CR-2003-212467; NAS 1.26:212467; E-14005; No Copyright; Avail: CASI; A04, Hardcopy

A study was conducted to define and assess the critical or enabling technologies required for a year 2005 entry into service (EIS) engine for subsonic commercial aircraft, with NASA Advanced Subsonic Transport goals used as benchmarks. The year 2005 EIS advanced technology engine is an Advanced Ducted Propulsor (ADP) engine. Performance analysis showed that the ADP design offered many advantages compared to a baseline turbofan engine. An airplane/ engine simulation study using a

long range quad aircraft quantified the effects of the ADP engine on the economics of typical airline operation. Results of the economic analysis show the ADP propulsion system provides a 6% reduction in direct operating cost plus interest, with half the reduction resulting from reduced fuel consumption. Critical and enabling technologies for the year 2005 EIS ADP were identified and prioritized.
Author
Subsonic Speed; Technological Forecasting; Turbofan Engines; Aircraft Engines; Economic Analysis

20030067980 Advanced Propulsion, Inc., Phoenix, AZ, USA
Efficient, Low-Cost Fan System Research for General Aviation and Commuter Aircraft
Eisenberg, J. D., Technical Monitor; Merrill, G. L.; August 2003; 80 pp.; In English
Contract(s)/Grant(s): NAS3-27644; WU-505-65-10
Report No.(s): NASA/CR-2003-212476; E-14014; NAS 1.26:212476; No Copyright; Avail: CASI; A05, Hardcopy

This document reports research investigations into efficient, low-cost fan system concepts for high bypass turbofans for future general aviation and commuter aircraft. The research specifically addressed lower pressure ratio fans for good propulsive efficiencies in the 200 to 400 knot flight speed regime. Aerodynamic design analyses yielded predicted efficiency in area of 91 to 92 percent (adiabatic). Low-cost manufacturing studies yielded an aluminum blisk rotor and investment cast stator having lowest cost. Structural design analyses yielded a design having excellent vibratory characteristics and the ability to pass One- and Four-pound bird strikes satisfactorily. The low speed and low pressure fans of the study are estimated to have 24 to 30 EPNdB lower community noise levels than larger, high pressure ratio transonic fans.
Author
Turbofans; Commuter Aircraft; General Aviation Aircraft; Design Analysis

20030067987 California Univ., Irvine, CA, USA
Detailed Studies of the Quick Mixing Region in Rich Burn Low-NO(x) Combustion
Samuelsen, G. S.; St.John, D.; August 2003; 82 pp.; In English
Contract(s)/Grant(s): NAG3-1110; WBS-22-714-01-38
Report No.(s): NASA/CR-2003-212316; E-13904; NAS 1.26:212316; No Copyright; Avail: CASI; A05, Hardcopy

NO(x) reduction is a driving force in combustor design today. The fuel-air mixing process can have a significant effect on NO(x) production. This report describes a set of experiments carried out to assess fuel-air mixing sensitivities to geometric variation in the Rich-Burn/Quick-Mix/Lean-Burn (RQL) combustor concept utilized in stationary gas turbine engine applications and proposed for advanced transport aircraft engines. Specifically, three (3) parameters in the quick-mix zone were examined: jet injection angle, jet-to-expansion distance, and jet count (number of jets).
Author
Nitrogen Oxides; Gas Turbine Engines; Jet Flow; Injection

20030068025 National Advisory Committee for Aeronautics. Langley Aeronautical Lab., Langley Field, VA, USA
Aerodynamic Heat-Power Engine Operating on a Closed Cycle
Ackeret, J.; Keller, D. C.; Zeitschrift des Vereines Deutscher Lagenieure; November 1942; Volume 85, No. 22, pp. 491-500; In English
Report No.(s): NACA-TM-1034; No Copyright; Avail: CASI; A03, Hardcopy

Hot-air engines with dynamic compressors and turbines offer new prospects of success through utilization of units of high efficiencies and through the employment of modern materials of great strength at high temperature. Particular consideration is given to an aerodynamic prime mover operating on a closed circuit and heated externally. Increase of the pressure level of the circulating air permits a great increase of limit load of the unit. This also affords a possibility of regulation for which the internal efficiency of the unit changes but slightly. The effect of pressure and temperature losses is investigated. A general discussion is given of the experimental installation operating at the Escher Wyss plant in Zurich for a considerable time at high temperatures.
Author
Aircraft Engines; Closed Cycles

20030068046 QSS Group, Inc., Cleveland, OH, USA

Resonance Effects in the NASA Transonic Flutter Cascade Facility

McFarland, Eric, Technical Monitor; Lepicovsky, J.; Capece, V. R.; Ford, C. T.; August 2003; 18 pp.; In English; Turbo Expo 2003, 16-19 Jun. 2003, Atlanta, GA, USA

Contract(s)/Grant(s): NAG3-2695; WBS 22-708-28-04

Report No.(s): NASA/CR-2003-212384; E-13962; NAS 1.26:212384; GT-2003-38344; No Copyright; Avail: CASI; A03, Hardcopy

Investigations of unsteady pressure loadings on the blades of fans operating near the stall flutter boundary are carried out under simulated conditions in the NASA Transonic Flutter Cascade facility (TFC). It has been observed that for inlet Mach numbers of about 0.8, the cascade flowfield exhibits intense low-frequency pressure oscillations. The origins of these oscillations were not clear. It was speculated that this behavior was either caused by instabilities in the blade separated flow zone or that it was a tunnel resonance phenomenon. It has now been determined that the strong low-frequency oscillations, observed in the TFC facility, are not a cascade phenomenon contributing to blade flutter, but that they are solely caused by the tunnel resonance characteristics. Most likely, the self-induced oscillations originate in the system of exit duct resonators. For sure, the self-induced oscillations can be significantly suppressed for a narrow range of inlet Mach numbers by tuning one of the resonators. A considerable amount of flutter simulation data has been acquired in this facility to date, and therefore it is of interest to know how much this tunnel self-induced flow oscillation influences the experimental data at high subsonic Mach numbers since this facility is being used to simulate flutter in transonic fans. In short, can this body of experimental data still be used reliably to verify computer codes for blade flutter and blade life predictions? To answer this question a study on resonance effects in the NASA TFC facility was carried out. The results, based on spectral and ensemble averaging analysis of the cascade data, showed that the interaction between self-induced oscillations and forced blade motion oscillations is very weak and can generally be neglected. The forced motion data acquired with the mistuned tunnel, when strong self-induced oscillations were present, can be used as reliable forced pressure fluctuations provided that they are extracted from raw data sets by an ensemble averaging procedure.

Author

Pressure Oscillations; Flutter Analysis; Forced Vibration; Prediction Analysis Techniques; Transonic Flutter; Flow Distribution

20030068048 Allied-Signal Engines and Systems, Phoenix, AZ, USA

Contingency Power Study for Short Haul Civil Tiltrotor

Eisenberg, Joseph D., Technical Monitor; Wait, John; July 2003; 110 pp.; In English

Contract(s)/Grant(s): NAS3-27481; WU 538-07-16

Report No.(s): NASA/CR-2003-212465; E-14003; NAS 1.26:212465; No Copyright; Avail: CASI; A06, Hardcopy

AlliedSignal Engines (AE) defined a number of concepts that significantly increased the horsepower of a turboshaft engine to accommodate the loss of an engine and enable the safe landing of a twin-engined, 40-passenger, short haul civil tiltrotor. From these concepts, 'Water/Methanol Injection,' a 'Better Power Turbine Than Required,' and a 'Secondary Combustor For Interturbine Reheat' were chosen, based on system safety and economics, for more detailed examination. Engine performance, mission, and cost analysis of these systems indicated contingency power levels of 26 to 70 percent greater than normal rated takeoff could be attained for short durations, thus enabling direct operating cost savings between 2 and 6 percent.

Author

Tilt Rotor Aircraft; Turboshafts; Turbine Engines; Propulsion System Performance; Short Haul Aircraft

20030068075 NASA Glenn Research Center, Cleveland, OH, USA

The Computing And Interdisciplinary Systems Office: Annual Review and Planning Meeting

Lytle, John K.; 2002 Computing and Interdisciplinary Systems Office Review and Planning Meeting; August 2003, pp. 15-22; In English; See also 20030068074; Original contains color illustrations; No Copyright; Avail: CASI; A02, Hardcopy

The goal of this research is to develop an advanced engineering analysis system that enables high-fidelity, multi-disciplinary, full propulsion system simulations to be performed early in the design process (a virtual test cell that integrates propulsion and information technologies). This will enable rapid, high-confidence, cost-effective design of revolutionary systems.

Derived from text

Computers; Cost Effectiveness; Performance Tests

20030068077 NASA Glenn Research Center, Cleveland, OH, USA

Multidisciplinary Analysis of a Hypersonic Engine

Suresh, Ambady; Stewart, Mark; 2002 Computing and Interdisciplinary Systems Office Review and Planning Meeting; August 2003, pp. 129-139; In English; See also 20030068074; Original contains color and black and white illustrations; No Copyright; Avail: CASI; A03, Hardcopy

The objective is to develop high fidelity tools that can influence ISTAR design In particular, tools for coupling Fluid-Thermal-Structural simulations RBCC/TBCC designers carefully balance aerodynamic, thermal, weight, & structural considerations; consistent multidisciplinary solutions reveal details (at modest cost) At Scram mode design point, simulations give details of inlet & combustor performance, thermal loads, structural deflections.

Derived from text

Thermal Simulation; Engine Inlets; Hypersonics; Combustion Chambers

20030068079 NASA Glenn Research Center, Cleveland, OH, USA

Coupled Fluid and Structural Analysis of Pump Stages for Space Propulsion Systems

Hah, Chunill; 2002 Computing and Interdisciplinary Systems Office Review and Planning Meeting; August 2003, pp. 115-127; In English; See also 20030068074; Original contains color and black and white illustrations; No Copyright; Avail: CASI; A03, Hardcopy

The objective is to develop a coupled fluid/structure analysis tool for rocket turbopumps, advance hardware concepts and designs, and improve safety, reliability, and cost of space transportation.

Derived from text

Aerospace Systems; Propulsion System Configurations; Space Transportation; Turbine Pumps; Propulsion System Performance

20030068080 Cincinnati Univ., OH, USA

High Fidelity Turbofan Engine Simulation

Turner, Mark G.; 2002 Computing and Interdisciplinary Systems Office Review and Planning Meeting; August 2003, pp. 79-87; In English; See also 20030068074; Original contains color illustrations; No Copyright; Avail: CASI; A02, Hardcopy

Topics discussed include: GE90 Full Engine Simulation; Method for Turbomachinery Simulation; Combustor Details Presented by Andrew Norris; Computer Timings; Turbomachinery Solutions; Power Balance; Future Plans.

Derived from text

Turbofan Engines; Turbomachinery

20030068081 NASA Glenn Research Center, Cleveland, OH, USA

NASA GRC/Aeronautics Overview

Sehra, Arun K.; 2002 Computing and Interdisciplinary Systems Office Review and Planning Meeting; August 2003, pp. 1-13; In English; See also 20030068074; Original contains color and black and white illustrations; No Copyright; Avail: CASI; A03, Hardcopy

Twenty-first-century aeropropulsion and power research will enable new transport engine and aircraft systems including: 1) Emerging ultralow noise and emissions with the use of intelligent turbofans; 2) Future distributed vectored propulsion with 24-hour operations and greater community mobility; 3) Research in hybrid combustion and electric propulsion systems leading to silent aircraft with near-zero emissions; and 4) The culmination of these revolutions will deliver an all-electric- powered propulsion system with zero-impact emissions and noise and high-capacity, on-demand operation

Derived from text

Aircraft Engines; Electric Propulsion; Hybrid Propellant Rocket Engines; Turbofans; Propulsion System Configurations

20030068084 NASA Glenn Research Center, Cleveland, OH, USA

Incorporation of Electrical Systems Models Into an Existing Thermodynamic Cycle Code

Freeh, Josh; 2002 Computing and Interdisciplinary Systems Office Review and Planning Meeting; August 2003, pp. 63-71; In English; See also 20030068074; Original contains color illustrations; No Copyright; Avail: CASI; A02, Hardcopy

Integration of entire system includes: Fuel cells, motors, propulsors, thermal/power management, compressors, etc. Use of existing, pre-developed NPSS capabilities includes: 1) Optimization tools; 2) Gas turbine models for hybrid systems; 3) Increased interplay between subsystems; 4) Off-design modeling capabilities; 5) Altitude effects; and 6) Existing transient

modeling architecture. Other factors inclde: 1) Easier transfer between users and groups of users; 2) General aerospace industry acceptance and familiarity; and 3) Flexible analysis tool that can also be used for ground power applications.
Derived from text
Aerospace Industry; Compressors; Fuel Cells; Gas Turbines

20030068085 NASA Glenn Research Center, Cleveland, OH, USA
Aircraft Engine Systems
Veres, Joseph P.; 2002 Computing and Interdisciplinary Systems Office Review and Planning Meeting; August 2003, pp. 73-78; In English; See also 20030068074; Original contains color illustrations; No Copyright; Avail: CASI; A02, Hardcopy

The objective is to develop the capability to numerically model the performance of gas turbine engines used for aircraft propulsion. This capability will provide turbine engine designers with a means of accurately predicting the performance of new engines in a system environment prior to building and testing. The 'numerical test cell' developed under this project will reduce the number of component and engine tests required during development. As a result, the project will help to reduce the design cycle time and cost of gas turbine engines. This capability will be distributed to U.S. turbine engine manufacturers and air framers. This project focuses on goals of maintaining U.S. superiority in commercial gas turbine engine development for the aeronautics industry.
Derived from text
Performance Prediction; Aircraft Engines; Engine Design; Gas Turbine Engines

20030068092 NASA Glenn Research Center, Cleveland, OH, USA
The Role of Instability Waves in Predicting Jet Noise
Goldstein, Marvin E.; Handler, Louis M.; July 2003; 18 pp.; In English; Ninth Aeroacoustics Conference and Exhibit, 12-14 May 2003, Hilton Head, SC, USA
Contract(s)/Grant(s): WBS 22-772-10-03
Report No.(s): NASA/TM-2003-212461; E-13892; NAS 1.15:212461; AIAA Paper 2003-3256; No Copyright; Avail: CASI; A03, Hardcopy

Debate over whether linear instability waves play a role in the prediction of jet noise has been going on for many years. Parallel mean flow models, such as the one proposed by Lilley, usually neglect these waves because they cause the solution to become infinite. The present paper solves the true non-parallel acoustic equations for a two-dimensional shear layer by using a vector Greens function and assuming small mean flow spread rate. The results show that linear instability waves must be accounted for in order to construct a proper causal solution to the problem.
Author
Jet Aircraft Noise; Green's Functions; Noise Prediction (Aircraft)

20030068101 Williams International, Walled Lake, MI, USA
Advanced Propulsion System Studies for General Aviation Aircraft
Eisenberg, Joseph D., Technical Monitor; German, Jon; July 2003; 129 pp.; In English
Contract(s)/Grant(s): NAS3-27636; WU-538-07-10
Report No.(s): NASA/CR-2003-212466; E-14004; NAS 1.26:212466; No Copyright; Avail: CASI; A07, Hardcopy

This final report addresses the following topics: Market Impact Analysis (1) assessment of general aviation, including commuter/regional, aircraft market impact due to incorporation of advanced technology propulsion system on acquisition and operating costs, job creation and/or manpower demand, and future fleet size; (2) selecting an aircraft and engine for the study by focusing on the next generation 19-passenger commuter and the Williams International FJ44 turbofan engine growth. Propulsion System Analysis Conducted mission analysis studies and engine cycle analysis to define a new commuter mission and required engine performance, define acquisition and operating costs and, select engine configuration and initiated preliminary design for hardware modifications required. Propulsion System Benefits (1) assessed and defined engine emissions improvements, (2) assessed and defined noise reduction potential and, (3) conducted a cost analysis impact study. Review of Relevant NASA Programs Conducted literature searches using NERAC and NASA RECON services for related technology in the emissions and acoustics area. Preliminary Technology Development Plans Defined plan to incorporate technology improvements for an FJ44-2 growth engine in performance, emissions, and noise suppression.
Author
General Aviation Aircraft; Turbofan Engines; Propulsion System Performance; Engine Design; Technology Utilization

20030068102 Honeywell Engines, Systems and Services, Phoenix, AZ, USA

Design and Test of Fan/Nacelle Models Quiet High-Speed Fan

Miller, Christopher J., Technical Monitor; Weir, Donald; July 2003; 265 pp.; In English; Original contains color and black and white illustrations

Contract(s)/Grant(s): NAS3-27752; WU-781-30-11

Report No.(s): NASA/CR-2003-212370; E-13946; NAS 1.26:212370; No Copyright; Avail: CASI; A12, Hardcopy

The Quiet High-Speed Fan program is a cooperative effort between Honeywell Engines & Systems (formerly AlliedSignal Engines & Systems) and the NASA Glenn Research Center. Engines & Systems has designed an advanced high-speed fan that will be tested on the Ultra High Bypass Propulsion Simulator in the NASA Glenn 9 x 15 foot wind tunnel, currently scheduled for the second quarter of 2000. An Engines & Systems modern fan design will be used as a baseline. A nacelle model is provided that is characteristic of a typical, modern regional aircraft nacelle and meets all of the program test objectives. Author

Turbofans; Noise Reduction; Nacelles

20030068103 NASA Glenn Research Center, Cleveland, OH, USA

Active Control of High Frequency Combustion Instability in Aircraft Gas-Turbine Engines

Corrigan, Bob, Technical Monitor; DeLaat, John C.; Chang, Clarence T.; September 2003; 15 pp.; In English; 16th International Symposium on Airbreathing Engines, 31 Aug. - 5 Sep. 2003, Cleveland, OH, USA

Contract(s)/Grant(s): WBS-22-708-28-13

Report No.(s): NASA/TM-2003-212611; E-14169; NAS 1.15:212611; ISABE-2003-1054; No Copyright; Avail: CASI; A03, Hardcopy

Active control of high-frequency (greater than 500 Hz) combustion instability has been demonstrated in the NASA single-nozzle combustor rig at United Technologies Research Center. The combustor rig emulates an actual engine instability and has many of the complexities of a real engine combustor (i.e. actual fuel nozzle and swirler, dilution cooling, etc.) In order to demonstrate control, a high-frequency fuel valve capable of modulating the fuel flow at up to 1kHz was developed. Characterization of the fuel delivery system was accomplished in a custom dynamic flow rig developed for that purpose. Two instability control methods, one model-based and one based on adaptive phase-shifting, were developed and evaluated against reduced order models and a Sectored-1-dimensional model of the combustor rig. Open-loop fuel modulation testing in the rig demonstrated sufficient fuel modulation authority to proceed with closed-loop testing. During closed-loop testing, both control methods were able to identify the instability from the background noise and were shown to reduce the pressure oscillations at the instability frequency by 30%. This is the first known successful demonstration of high-frequency combustion instability suppression in a realistic aero-engine environment. Future plans are to carry these technologies forward to demonstration on an advanced low-emission combustor.

Author

Active Control; High Frequencies; Combustion Stability; Aircraft Engines; Gas Turbine Engines

20030068105 NASA Glenn Research Center, Cleveland, OH, USA

The Role of Design-of-Experiments in Managing Flow in Compact Air Vehicle Inlets

Anderson, Bernhard H.; Miller, Daniel N.; Gridley, Marvin C.; Agrell, Johan; September 2003; 18 pp.; In English; Vehicle Propulsion Integration Symposium, 6-9 Oct. 2003, Warsaw, Poland

Contract(s)/Grant(s): WBS-22-708-92-24

Report No.(s): NASA/TM-2003-212601; E-14158; NAS 1.15:212601; No Copyright; Avail: CASI; A03, Hardcopy

It is the purpose of this study to demonstrate the viability and economy of Design-of-Experiments methodologies to arrive at microscale secondary flow control array designs that maintain optimal inlet performance over a wide range of the mission variables and to explore how these statistical methods provide a better understanding of the management of flow in compact air vehicle inlets. These statistical design concepts were used to investigate the robustness properties of low unit strength micro-effector arrays. Low unit strength micro-effectors are micro-vanes set at very low angles-of-incidence with very long chord lengths. They were designed to influence the near wall inlet flow over an extended streamwise distance, and their advantage lies in low total pressure loss and high effectiveness in managing engine face distortion. The term robustness is used in this paper in the same sense as it is used in the industrial problem solving community. It refers to minimizing the effects of the hard-to-control factors that influence the development of a product or process. In Robustness Engineering, the effects of the hard-to-control factors are often called noise , and the hard-to-control factors themselves are referred to as the environmental variables or sometimes as the Taguchi noise variables. Hence Robust Optimization refers to minimizing the effects of the environmental or noise variables on the development (design) of a product or process. In the management of flow

in compact inlets, the environmental or noise variables can be identified with the mission variables. Therefore this paper formulates a statistical design methodology that minimizes the impact of variations in the mission variables on inlet performance and demonstrates that these statistical design concepts can lead to simpler inlet flow management systems.
Author
Engine Inlets; Experiment Design; Aerodynamics; Computational Fluid Dynamics; Robustness (Mathematics); Flow Distribution

20030068129 NASA Glenn Research Center, Cleveland, OH, USA
Overview of Innovative Aircraft Power and Propulsion Systems and Their Applications for Planetary Exploration
Colozza, Anthony; Landis, Geoffrey; Lyons, Valerie; July 2003; 19 pp.; In English; International Air and Space Symposium and Exposition, 14-17 July 2003, Dayton, OH, USA
Contract(s)/Grant(s): WBS-22-755-04-02
Report No.(s): NASA/TM-2003-212459; E-13998; NAS 1.15:212459; No Copyright; Avail: CASI; A03, Hardcopy

Planetary exploration may be enhanced by the use of aircraft for mobility. This paper reviews the development of aircraft for planetary exploration missions at NASA and reviews the power and propulsion options for planetary aircraft. Several advanced concepts for aircraft exploration, including the use of in situ resources, the possibility of a flexible all-solid-state aircraft, the use of entomopters on Mars, and the possibility of aerostat exploration of Titan, are presented.
Author
Aircraft Engines; Space Exploration; General Overviews; Space Missions; Propulsion System Configurations; NASA Space Programs

20030068170 Teledyne Ryan Aeronautical Co., Toledo, OH, USA
Advanced Propulsion System Studies for General Aviation Aircraft
Eisenberg, Joseph D., Technical Monitor; Elliott, Kathryn A.; Huebner, Steven R.; August 2003; 123 pp.; In English; Original contains black and white illustrations
Contract(s)/Grant(s): NAS3-27635; WU 22-538-07-10
Report No.(s): NASA/CR-2003-212469; E-14007; NAS 1.26:212469; TRA-3043; No Copyright; Avail: CASI; A06, Hardcopy

In this study, new technology engines were defined in two power classes: a 200 hp class, for a light, 4-place personal aircraft, and a 1500 pound thrust class for a twin-engined, 6 place business jet type aircraft. The engines were evaluated for retrofitting suitable current production aircraft for comparison to the existing engines. The engines were evaluated for performance using a typical mission for each aircraft, as well as a variant mission to further appraise performance.Issues of cost, safety, maintenance, and reliability were also addressed. Manufacturing plans were then constructed.
Author
General Aviation Aircraft; Turboprop Engines

20030068256 NASA Glenn Research Center, Cleveland, OH, USA
Towards an Automated Full-Turbofan Engine Numerical Simulation
Reed, John A.; Turner, Mark G.; Norris, Andrew; Veres, Joseph P.; August 2003; 15 pp.; In English; 16th International Symposium on Airbreathing Engines, 31 Aug. - 5 Sep. 2003, Cleveland, OH, USA; Original contains color illustrations
Contract(s)/Grant(s): WBS 22-708-87-01; WBS 22-714-01-19
Report No.(s): NASA/TM-2003-212494; E-14050; NAS 1.15:212494; Copyright; Avail: CASI; A03, Hardcopy

The objective of this study was to demonstrate the high-fidelity numerical simulation of a modern high-bypass turbofan engine. The simulation utilizes the Numerical Propulsion System Simulation (NPSS) thermodynamic cycle modeling system coupled to a high-fidelity full-engine model represented by a set of coupled three-dimensional computational fluid dynamic (CFD) component models. Boundary conditions from the balanced, steady-state cycle model are used to define component boundary conditions in the full-engine model. Operating characteristics of the three-dimensional component models are integrated into the cycle model via partial performance maps generated automatically from the CFD flow solutions using one-dimensional meanline turbomachinery programs. This paper reports on the progress made towards the full-engine simulation of the GE90-94B engine, highlighting the generation of the high-pressure compressor partial performance map. The ongoing work will provide a system to evaluate the steady and unsteady aerodynamic and mechanical interactions between engine components at design and off-design operating conditions.
Author
Turbofan Engines; Engine Parts

20030068273 NASA Glenn Research Center, Cleveland, OH, USA

Test Rig for Evaluating Active Turbine Blade Tip Clearance Control Concepts

Lattime, Scott B.; Steinetz, Bruce M.; Robbie, Malcolm G.; July 2003; 30 pp.; In English; 39th AIAA/ASME/SAE/ASEE Joint Propulsion Conference and Exhibit, 20-23 Jul. 2003, Huntsville, AL, USA; Original contains color illustrations

Contract(s)/Grant(s): WBS-22-708-87-06

Report No.(s): NASA/TM-2003-212533; E-14097; NAS 1.15:212533; AIAA Paper 2003-4700; No Copyright; Avail: CASI; A03, Hardcopy

Improved blade tip sealing in the high pressure compressor and high pressure turbine can provide dramatic improvements in specific fuel consumption, time-on-wing, compressor stall margin and engine efficiency as well as increased payload and mission range capabilities of both military and commercial gas turbine engines. The preliminary design of a mechanically actuated active clearance control (ACC) system for turbine blade tip clearance management is presented along with the design of a bench top test rig in which the system is to be evaluated. The ACC system utilizes mechanically actuated seal carrier segments and clearance measurement feedback to provide fast and precise active clearance control throughout engine operation. The purpose of this active clearance control system is to improve upon current case cooling methods. These systems have relatively slow response and do not use clearance measurement, thereby forcing cold build clearances to set the minimum clearances at extreme operating conditions (e.g., takeoff, re-burst) and not allowing cruise clearances to be minimized due to the possibility of throttle transients (e.g., step change in altitude). The active turbine blade tip clearance control system design presented herein will be evaluated to ensure that proper response and positional accuracy is achievable under simulated high-pressure turbine conditions. The test rig will simulate proper seal carrier pressure and temperature loading as well as the magnitudes and rates of blade tip clearance changes of an actual gas turbine engine. The results of these evaluations will be presented in future works.

Author

Blade Tips; Sealing; Turbine Blades

20030068448 National Advisory Committee for Aeronautics. Langley Aeronautical Lab., Langley Field, VA, USA

Preliminary Report on the Fundamentals of the Control of Turbine-Propeller Jet Power Plant

Kuhl, H.; July 1947; 39 pp.; In English

Report No.(s): NACA-TM-1172; No Copyright; Avail: CASI; A03, Hardcopy

On the basis of the investigations so far completed on the behavior of PTL power plants under various operating conditions, in which the influence of the propeller characteristics is of considerable importance, the most important aspects of a control system for turbine-propeller jet power plants are deduced. A simple possible means for its concrete realization, which is also applicable to TL [NACA comment: TL, jet] power plants, is presented by means of examples. A control device of this kind is now being developed.

Author

Turboprop Engines; Engine Control

20030068451 National Advisory Committee for Aeronautics. Langley Aeronautical Lab., Langley Field, VA, USA

Description of Russian Aircraft Engines 'AM 35' and 'AM 38'

Denkmeier, H.; Gross, K.; June 1947; 24 pp.; In English; Original contains black and white illustrations

Report No.(s): NACA-TM-1169; No Copyright; Avail: CASI; A03, Hardcopy

The Russian AM 35 and AM 38 aircraft engines have superchargers with a swirl throttle, which appears to be a purely Russian development. This paper gives the results of test runs of the two engines, including the effects of the swirl throttle on engine performance.

CASI

Aircraft Engines; Superchargers; Performance Tests; Engine Tests; Engine Parts

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*.

20030067831 Zentrale fuer Wissenschaftliches Berichtswesen, Berlin, Germany
Wind-Tunnel Measurements on the Henschel Missile 'Zitterrochen' in Subsonic and Supersonic Velocities
Weber; Kehl; Deutsche Luftfahrtforschung, Untersuchungen und Mitteilungen; April 1948; 33 pp.; In English; See also 20030067832 - 20030067832
Report No.(s): NACA-TM-1159; DLUM-3122; No Copyright; Avail: CASI; A03, Hardcopy

At the reauest of tho Rknschel AirOraft Works. A. G. Beriln. thres rmdels of the missils 'Zitterrochen' were investigated at subsonic velocities.(open jet 215-millimeter diameter) and at supersonic velocities (open jet 110 by 130 millimeters) in order to determine the effect of various wing forms on the air forces and moments. Three-component measurements were taken, and one model was also investigated with deflected control plates.
Author
Wind Tunnel Tests; Velocity Distribution; Missile Configurations; Subsonic Speed; Supersonic Speed; Control Surfaces

20030067832 Zentrale fuer Wissenschaftliches Berichtswesen, Berlin, Germany
Wind-Tunnel Measurements on the Wing of the Henschel Missile 'Zitterrochen' in Subsonic and Supersonic Velocities
Kehl; Wind-Tunnel Measurements on the Henschel Missile 'Zitterrochen' in Subsonic and Supersonic Velocities; April 1948, pp. 23-31; In English; See also 20030067831
Report No.(s): DLUM-3161; No Copyright; Avail: CASI; A02, Hardcopy

Supplementing the measured results previously reported, this investigation of three-component measurements on a wing model of the missile 'ZR 2.0' was conducted in the subsonic wind tunnel (open-jet 215-millimeter diameter) and in the supersonic wind tunnel (open jet 110 by 130 millimeters) at the request of the Henschel Aircraft Works, Berlin.
Author
Wind Tunnel Tests; Wings; Missile Configurations; Subsonic Wind Tunnels; Supersonic Wind Tunnels

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)*.

20030067971 Draper (Charles Stark) Lab., Inc., Cambridge, MA, USA
Analysis and Modeling of Ground Operations at Hub Airports
Atkins, Stephen, Technical Monitor; Andersson, Kari; Carr, Francis; Feron, Eric; Hall, William D.; [2000]; 15 pp.; In English; 3rd USA/Europe Air Traffic Management R and D Seminar, 13-16 Jun. 2000, Naples, Italy
Contract(s)/Grant(s): NCC2-1147; NAG2-1128; No Copyright; Avail: CASI; A03, Hardcopy

Building simple and accurate models of hub airports can considerably help one understand airport dynamics, and may provide quantitative estimates of operational airport improvements. In this paper, three models are proposed to capture the dynamics of busy hub airport operations. Two simple queuing models are introduced to capture the taxi-out and taxi-in processes. An integer programming model aimed at representing airline decision-making attempts to capture the dynamics of the aircraft turnaround process. These models can be applied for predictive purposes. They may also be used to evaluate control strategies for improving overall airport efficiency.
Author
Airline Operations; Ground Operational Support System; Decision Making; Airports

20030068018 Naval Postgraduate School, Monterey, CA
The Mobile Aircraft Maintenance Office Concept from a Wide Area Perspective
Perrella, Sil A.; Mar. 2003; 123 pp.; In English; Original contains color illustrations
Report No.(s): AD-A415167; No Copyright; Avail: CASI; A06, Hardcopy

As mobile computing becomes more ubiquitous, through the use of very capable mobile computing devices and

broadband wide-area wireless data networks, naval aviation maintenance has an opportunity to extend the reach of the Naval Aviation Logistics Command Management Information System (NALCOMIS) to fielded aircrew, maintenance technicians, and maintenance supervisors supporting out-of-local-area operations. The combination of the new mobile technologies and the wireless Internet makes modern Mobile Business (m-business) initiatives possible, but ushers in a host of new problems and issues that are radically different from those experienced with traditional fixed electronic business (e-business) projects. This thesis examines the concept and components that comprise m-business, details wide-area data over cellular technologies, and identifies problems and issues unique to m-business initiatives. Scenario-based 'Use Cases' will be employed within the Unified Process (UP) framework to develop the three major artifacts of the UP's inception phase: the project's vision, a Use Case model, and a supplemental specification containing functional and non-functional requirements for an aircrew mobile aircraft maintenance application. The results of this study can serve as the foundation for the development of a complete mobile aircraft maintenance office. A detailed survey of the evolution of cellular technologies; a review of the Third Generation Wireless (3G) specification; the issues surrounding 3G's implementation; and an in-depth technical discussion of the two most predominant 3G system architectures, data capabilities, and required protocols is presented in the three appendices and are referenced throughout the thesis.
DTIC
Management Information Systems; Aircraft Maintenance; Wide Area Networks; Wireless Communication; Networks; Architecture (Computers)

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*.

20030067759 Nebraska Univ., Omaha, NE, USA
2002 Aerial Monograph
Bowen, Brent D.; Nickerson, Jocelyn S.; Fink, Mary M.; The Aeronautics Education, Research, and Industry Alliance (AERIAL) 2002 Report; November 2002, pp. 1-11; In English; See also 20030067758; No Copyright; Avail: CASI; A03, Hardcopy

The NASA Nebraska Space Grant Consortium (NSGC) and EPSCoR programs at the University of Nebraska at Omaha are involved in a variety of innovative research activities supported through the Aeronautics Education, Research, and Industry Alliance (AERIAL) and collaborative seed funds. AERIAL is a comprehensive, multi-faceted, five year NASA EPSCoR initiative that contributes substantially to the strategic research and technology priorities of NASA while intensifying Nebraska's rapidly growing aeronautics research and development endeavors.The emerging research is addressed for the following areas: spaceports that to support NASA#s commercialization of the space launch initiative, geospatial research and the Nebraska Native American Outreach Program (NNAOP).
Author
Space Commercialization; Aircraft Safety; Spacecraft Launching

20030068342 Battelle Memorial Inst., Columbus, OH, Federal Aviation Administration, Atlantic City, NJ, USA
Metallic Materials Properties Development and Standardization (MMPDS)
Rice, R. C.; Jackson, J. L.; Bakuckas, J.; Thompson, S.; Jan. 2003; 1732 pp.; In English
Report No.(s): PB2003-106632; No Copyright; Avail: CASI; A99, Hardcopy

The Metallic Material Properties Development and Standardization (MMPDS) Handbook is the replacement document for MILHDBK- 5. It is recognized internationally as a reliable source of aircraft materials data for aerospace materials selection and analysis. Consistent and reliable methods are used to collect, analyze, and present statistically based material and fastener allowable properties. The Handbook is the only publicly available source in the U. S. for material allowables that the Federal Avaiation Administration generally accepts for compliance with Federal Aviation Regulations (FAR) for material strength properties and design values for aircraft certification and continued airworthiness. Moreover, it is the only publicly available source worldwide for fastener joint allowables that comply with the FARs. This edition, MMPDS-01, incorporates the additions and changes to aircraft metallic material design properties and analysis guidelines approved at the 1st and 2nd MMPDS government/industry coordination meetings. This year, 2003, marks the first year of publication of the MMPDS

Handbook and the final year of publication of MIL-HDBK-5. For this year only, MMPDS-01 and MIL-HDBK-5J will be technically equivalent. In the spring of 2004, when the 1st Change Notice of MMPDS-01 is published, MIL-HDBK-5 will be designated noncurrent and MMPDS will become the only governmentrecognized source in the U.S. of published design allowable properties for metallic commercial and military aircraft structures and mechanically fastened joints. In this way, the 65-year legacy of MIL-HDBK-5, and its predecessor ANC-5, will be maintained.
NTIS
Materials; Handbooks

20030068352 Department of Transportation, Washington, DC, USA
Commercial Space Transportation: 2002 Year in Review
Jan. 2003; In English
Report No.(s): PB2003-106643; No Copyright; Avail: National Technical Information Service (NTIS)

This report summarizes U.S. and international launch activities for calendar year 2002 and provides a historical look at the past five years of commercial launch activities. The Federal Aviation Administration's Associate Administrator for Commercial Space Transportation (FAA/AST) licensed six commercial orbital launches in 2002, all of which were successful. Of the six FAA/AST-licensed launches in 2002, five were of U.S.-built vehicles, including the introduction of two new launch vehicles. ILS launched the first Atlas 5, Lockheed Martin's contribution to the U. S. Air Force Evolved Expendable Launch Vehicle (EELV) program, which lofted Hot Bird 6 into geosynchronous Earth orbit (GEO). ILS also launched an Atlas 2AS and an Atlas 3B for commercial customers. Boeing Launch Services (BLS) successfully launched the first Delta 4, Boeing's EELV entrant, which carried Eutelsat W5, as well as a single Delta 2 for Iridium Satellite, LLC. Overall, 24 commercial orbital launches occurred worldwide in 2002, representing 37 percent of the 65 total launches for the year. The 24 commercial launches represent an increase of 50 percent from 2001, but the total remains significantly lower than in prior years (35 in 2000 and 39 in 1999).
NTIS
Market Research; Launch Vehicles; Earth Orbits; Space Transportation

20030068376 Department of Transportation, Washington, DC, USA
Commercial Space Transportation: 2000 Year in Review
Jan. 2001; In English
Report No.(s): PB2003-106642; No Copyright; Avail: National Technical Information Service (NTIS)

In 2000, there were ten commercial launches licensed by the Federal Aviation Administration (FAA) for revenue that totaled about $625 million. This total represents seven launches from U.S. ranges for commercial and government customers plus three launches by the multinational Sea Launch venture. Overall, 35 worldwide commercial launches occurred in 2000. This number is slightly less than prior years (39 in 1999 and 41 in 1998). However, the U.S. percentage of commercial launches declined more precipitously. There were seven U.S. commercial launches in 2000, or 20 percent of the world total. The USA captured 38 percent of the commercial launches in 1999 and 54 percent in 1998. Also, the ten launches licensed by the FAA in 2000 were fewer than expected and represented a decrease from prior years (17 in 1999 and 22 in 1998). 3A vehicle, which deployed a communications spacecraft for Eutelsat.
NTIS
Commercial Spacecraft; Launch Vehicles

20030068396 Department of Transportation, Washington, DC, USA
Commercial Space Transportation: 1998 Year in Review
Jan. 1999; In English
Report No.(s): PB2003-106640; No Copyright; Avail: National Technical Information Service (NTIS)

In 1998, U.S. launch service providers conducted 22 launches licensed by the Federal Aviation Administration (FAA), an increase of 29 percent over the 17 launches conducted in 1997. Of these 22, 17 were for commercial or international customers, resulting in a 47 percent share of the world's market for commercial launches. Revenues from the FAA-licensed space launches surpassed the $1 billion mark for the first time in 1998, reaching $1,119 million, an increase of 19 percent over 1997 revenues of $940 million. Over the past five years, revenues have increased by more than a factor of three, up from $353 million in 1994. This report has three parts: 1998 FAA-Licensed Commercial Activity; 1998 Worldwide Launch Activity; Five-Year Space Transportation Trends.
NTIS
Launch Vehicles; Market Research; Spacecraft Launching; Space Transportation

20030068397 Department of Transportation, Washington, DC, USA
Commercial Space Transportation: 1999 Year in Review
Jan. 2000; In English
Report No.(s): PB2003-106641; No Copyright; Avail: National Technical Information Service (NTIS)

In 1999, U.S. launch service providers conducted 17 launches licensed by the Federal Aviation Administration (FAA) for revenue that totaled about $851 million. U.S. launch service providers captured a 36-percent share of the 36 total commercial launches worldwide, conducting 13 launches for commercial or international customers. U.S. launch providers also conducted 2 launches for U.S. government customers and the international Sea Launch venture conducted 2 launches licensed by the FAA. Several events in 1999 resulted in fewer launches and lower revenues than expected. Launch failures caused delays in multiple vehicle programs and prompted governmental and internal program reviews. Delays in certain satellite programs also depressed the anticipated launch rate.

NTIS
Commercial Spacecraft; Space Industrialization; Launch Vehicles

20030068400
Commercial Spacecraft Mission Model Update, May 1998
Fuller, P.; May 1998; 44 pp.; In English
Report No.(s): PB2003-106650; No Copyright; Avail: CASI; A03, Hardcopy

The Federal Aviation Administration's (FAA) Office of the Associate Administrator for Commercial Space Transportation (AST) of the U.S. Department of Transportation (DOT) endeavors to foster a healthy commercial space launch capability in the USA. An important element of these efforts is to establish the commercial space industry's view of future space launch requirements. Since 1993, the DOT has requested that its industry advisory group, the Commercial Space Transportation Advisory Committee (COMSTAC), prepare and maintain a commercial spacecraft launch demand mission model. This report presents the 1998 update of the worldwide commercial geosynchronous transfer orbit (GTO) satellite mission model for the period 1998 through 2010. It is based on market forecasts obtained in early 1998 from major spacecraft manufacturers, satellite operators and launch service providers. The mission model is limited to addressable payloads only (i.e., payloads open to internationally competed launch service procurements). Payloads captive to any launch systems are excluded from the mission model. Note that the number of projected vehicle launches per year is a subset of this payload launch demand forecast due to the potential for multiple manifesting of satellites on launch vehicles. Also, low-earth orbit (LEO) and medium-earth orbit (MEO) payloads are not included in this mission model. The FAA/AST develops the LEO/MEO market forecasts in a separate report using a different forecast methodology.

NTIS
Commercial Spacecraft; Space Transportation; Launch Vehicles

20030068466
Fourth Annual Federal Aviation Administration Commercial Space Transportation Forecast Conference
Feb. 06, 2001; In English, February 6, 2001, Arlington, Virginia
Report No.(s): PB2003-106651; No Copyright; Avail: National Technical Information Service (NTIS)

This document presents the fourth annual Federal Aviation Administration Commercial Space Transportation Forecast conference in the Sheraton National Hotel at Arlington, Virginia on February 6, 2001. Patricia Grace Smith, Associate for Commercial Space Transportation, was in charge of the meeting.

NTIS
Forecasting; Conferences; Space Transportation

14
GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE)

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

20030067927 NASA Marshall Space Flight Center, Huntsville, AL, USA
Capabilities of the Materials Contamination Team at Marshall Space Flight Center
Burns, H. D.; Finckenor, M. M.; Boothe, R. E.; Albyn, K. C.; Finchum, C. A.; July 2003; 31 pp.; In English; Original contains black and white illustrations
Report No.(s): NASA/TP-2003-212634; NAS 1.60:212634; M-1081; No Copyright; Avail: CASI; A03, Hardcopy

The Materials Contamination Team of the Environmental Effects Group, Materials, Processes, and Manufacturing Department, has been recognized for its contribution to space flight, including space transportation, space science and flight projects, such as the reusable solid rocket motor, Chandra X-Ray Observatory, and the International Space Station. The Materials Contamination Team s realm of responsibility encompasses all phases of hardware development including design, manufacturing, assembly, test, transportation, launch-site processing, on-orbit exposure, return, and refurbishment if required. Contamination is a concern in the Space Shuttle with sensitivity bondlines and reactive fluid (liquid oxygen) compatibility as well as for sensitive optics, particularly spacecraft such as Hubble Space Telescope and Chandra X-Ray Observatory. The Materials Contamination Team has a variety of facilities and instrumentation capable of contaminant detection identification, and monitoring. The team addresses material applications dealing with environments, including production facilities, clean rooms, and on-orbit exposure. The team of engineers and technicians also develop and evaluates new surface cleanliness inspection technologies. Databases are maintained by the team for proces! materials as well as outgassing and optical compatibility test results for specific environments.
Author
Contamination; International Space Station; NASA Space Programs; Materials Tests

20030067944 NASA Marshall Space Flight Center, Huntsville, AL, USA
A Ground Systems Architecture Transition for a Distributed Operations System
Sellers, Donna; Pitts, Lee; Bryant, Barry; [2003]; 38 pp.; In English; SpaceOps 2002 Conference, 9-12 Oct. 2002, Houston, TX, USA; No Copyright; Avail: CASI; A03, Hardcopy

The Marshall Space Flight Center (MSFC) Ground Systems Department (GSD) recently undertook an architecture change in the product line that serves the ISS program. As a result, the architecture tradeoffs between data system product lines that serve remote users versus those that serve control center flight control teams were explored extensively. This paper describes the resulting architecture that will be used in the International Space Station (ISS) payloads program, and the resulting functional breakdown of the products that support this architecture. It also describes the lessons learned from the path that was followed, as a migration of products cause the need to reevaluate the allocation of functions across the architecture. The result is a set of innovative ground system solutions that is scalable so it can support facilities of wide-ranging sizes, from a small site up to large control centers. Effective use of system automation, custom components, design optimization for data management, data storage, data transmissions, and advanced local and wide area networking architectures, plus the effective use of Commercial-Off-The-Shelf (COTS) products, provides flexible Remote Ground System options that can be tailored to the needs of each user. This paper offers a description of the efficiency and effectiveness of the Ground Systems architectural options that have been implemented, and includes successful implementation examples and lessons learned.
Author
Architecture (Computers); Data Transmission; Data Management; Data Systems

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*.

20030067776 Army Research Lab., White Sands Missile Range, NM, USA
Enhancement of Army Operational Capabilities With the Use of NPOESS Data
O'Brien, Sean G.; Shirkey, Richard C.; Sauter, Barbara J.; Mar. 2003; 59 pp.; In English
Report No.(s): AD-A414750; ARL-TR-2789; No Copyright; Avail: CASI; A04, Hardcopy

When compared with the current Defense Meteorological Satellite Program (DMSP) system, the proposed National Polar-Orbiting Operational Environmental Satellite System (NPOESS) will provide superior spatial and parametric resolution for environmental parameters that are significant in Army operations. Two tactical decision aid models used by the Army, the Night vision goggles Operations Weather Software (NOWS) and the Target Acquisition Weapons Software (TAWS), where used to evaluate the degree of improvement that is possible in target acquisition predictions because of the enhanced accuracy of NPOESS measurements. Before performing this evaluation, we first identified the most significant parameters for selected night vision goggle and infrared low altitude sensors during a few environmental scenarios. We then examined the relative impact that several of these environmental parameters had on the detection range predictions from the NOWS and TAWS models during the selected scenarios. The most significant parameters were examined in detail to display the quantitative effect that the increased NPOESS resolution has on the uncertainty in NOWS/TWAS detection range estimates. We also examined

the effect that delays in supplying an environmental input to NOWS or TAWS (data latency) have on the accuracy of detection range predictions. Then the improvement in allocation of search assets during adverse weather conditions, which resulted from the use of NPOESS-resolution data, was considered. Finally, new output quantities from TAWS that will be required as input to combat attrition models were identified for future implementation.
DTIC
Combat; Dmsp Satellites; Decision Support Systems; Infrared Detectors; Weather

20030067804 Air Force Research Lab., Edwards AFB, CA
In-Space Propulsion
Gulezinksi III, Frank; Spores, Ronald A.; Stuhlberger, Johanes; Apr. 25, 2003; 28 pp.; In English
Contract(s)/Grant(s): Proj-6340
Report No.(s): AD-A414779; AFRL-PR-ED-TP-2003-105; No Copyright; Avail: CASI; A03, Hardcopy

As the world of flight enters its second century, in-space propulsion nears the end of its first 50 years. The field is progressing rapidly, with a diversification of propulsion technologies that enable space missions that were previously untenable. This paper will summarize the state of the art and current development efforts for the major classes of spacecraft propulsion: chemical, electric, and solar thermal. Chemical propulsion systems remain the backbone of spacecraft architectures. Work continues to improve the performance, storability, and environmental friendliness of liquid monopropellant, bipropellant, cold gas, and gel systems for orbital insertion, stationkeeping, orbital maneuvering, and attitude control. Electric propulsion, once the 'technology of tomorrow' has entered the mainstream of in-space propulsion, establishing operability for stationkeeping and orbital insertion and being baselined for next generation scientific deep space and interferometry missions. Research efforts are now concentrated primarily on expanding the applicable power range for electric propulsion systems in order to enable large orbit transfer vehicle applications and micro/nano spacecraft propulsion systems. Solar thermal propulsion is also discussed. A comprehensive research and development effort is ongoing in the USA and Europe in industrial, academic, and national laboratory settings to advance the state of the art for spacecraft propulsion systems. Apart from technological developments in these various fields, the economic pressure on both commercial and scientific missions is increasing and customers require an industrialization of space businesses. Improvements in these areas have been achieved within the Astrium EUROSTAR and Alcatel SPACEBUS series.
DTIC
Space Missions; Spacecraft Propulsion

20030068394
FAA and Industry Guide to Reusable Launch Vehicle Operations Safety Approvals, Version 1.0
May 2002; 46 pp.
Report No.(s): PB2003-106648; No Copyright; Avail: CASI; A03, Hardcopy

This guide describes the Reusable Launch Vehicle (RLV) Operations Safety Approval Process used by the Federal Aviation Administration (FAA) in partnership with industry to assess the safety of proposed commercial RLV concepts. Tasks that need to be performed by the Applicant and the FAA to issue these approvals, certificates, and licenses are discussed. The guide provides an overview of how to plan, manage, and control an effective and efficient safety approval process for RLVs and details the working relationship between the FAA and the Applicant. Although this guide focuses on large, complex programs, the principles of up-front planning, project management, and thorough documentation discussed here apply to all RLV applications. It must be noted that this safety approval process leads to the licensing of space launches. Following the safety approvals, the FAA makes a determination on the issuance of a license.
NTIS
Reusable Launch Vehicles; Licensing

20030068925 NASA Marshall Space Flight Center, Huntsville, AL, USA
Enhancements to an Atmospheric Ascent Guidance Algorithm
Dukeman, Greg A.; June 09, 2003; 7 pp.; In English; AIAA Guidance, Navigation and Control Conference, 11-14 Aug. 2003, Austin, TX, USA; No Copyright; Avail: CASI; A02, Hardcopy

Enhancements to an advanced ascent guidance algorithm for rocket-powered launch vehicles are described. A general method has been developed for conveniently and efficiently handling the common case of (asymmetric) launch vehicles with unbalanced thrust and aerodynamic moments. The new part of this development concerns the treatment of endo-atmospheric flight. An alternative method for handing the transversality conditions has been developed that eliminates the need for a priori

elimination of the constant multipliers that adjoin the terminal state constraints to the performance index. As a result, new constraints can be formulated and implemented with relative ease. The problem of burn-coast-burn trajectory optimization is treated using a modified multiple shooting technique.
Author
Algorithms; Ascent; Launch Vehicles; Trajectory Optimization; Guidance (Motion); Mathematical Models; Augmentation

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SPACE TRANSPORTATION AND SAFETY

Includes passenger and cargo space transportation, e.g., shuttle operations; and space rescue techniques. For related information see also *03 Air Transportation and Safety; 15 Launch Vehicles and Launch Operations*; and *18 Spacecraft Design, Testing and Performance*. For space suits see *54 Man/System Technology and Life Support*.

20030067842 NASA Marshall Space Flight Center, Huntsville, AL, USA
NASA's Space Environments and Effects (SEE) Program
Kauffman, Billy; Hardage, Donna; Minor, Jody; Barth, Janet; LaBel, Ken; [2003]; 29 pp.; In English; AIAA/ICAS International Air and Space Symposium and Exposition: The Next 100 Years, 14-18 Jul. 2003, Dayton, OH, USA; No Copyright; Avail: CASI; A03, Hardcopy

This viewgraph presentation gives a broad overview of NASA's Space Enivronments and Effects (SEE) Program. The purpose of the program is to protect spacecraft and their systems from damage by radiation, spacecraft charging, micrometeoroids, contamination, and other hazards posed by aerospace environments. The presentation profiles SEE activities to address each of these hazards. SEE is responsible for overseeing research and product development with a variety of partners.
CASI
NASA Programs; Aerospace Environments; Environment Effects; Hazards; Damage; Product Development

20030067855 NASA Glenn Research Center, Cleveland, OH, USA
High Power Nuclear Electric Propulsion (NEP) for Cargo and Propellant Transfer Missions in Cislunar Space
Falck, Robert D.; Borowski, Stanley K.; July 2003; 10 pp.; In English; Space Technology and Applications International Forum (STAIF-2003), 2-6 Feb. 2003, Albuquerque, NM, USA
Contract(s)/Grant(s): WBS 22-706-87-02
Report No.(s): NASA/TM-2003-212227; E-13847; NAS 1.15:212227; No Copyright; Avail: CASI; A02, Hardcopy

The performance of Nuclear Electric Propulsion (NEP) in transporting cargo and propellant from Low Earth Orbit (LEO) to the first Earth-Moon Lagrange point (EML1) is examined. The baseline NEP vehicle utilizes a fission reactor system with Brayton power conversion for electric power generation to power multiple liquid hydrogen magnetoplasmadynamic (MPD) thrusters. Vehicle characteristics and performance levels are based on technology availability in a fifteen to twenty year timeframe. Results of numerical trajectory analyses are also provided.
Author
Cislunar Space; Low Earth Orbits; Nuclear Electric Propulsion; Propellant Transfer; Brayton Cycle

20030067856 NASA Marshall Space Flight Center, Huntsville, AL, USA
Microgravity Manufacturing Via Fused Deposition
Cooper, K. G.; Griffin, M. R.; July 2003; 17 pp.; In English
Report No.(s): NASA/TM-2003-212636; NAS 1.15:212636; M-1083; No Copyright; Avail: CASI; A03, Hardcopy

Manufacturing polymer hardware during space flight is currently outside the state of the art. A process called fused deposition modeling (FDM) can make this approach a reality by producing net-shaped components of polymer materials directly from a CAE model. FDM is a rapid prototyping process developed by Stratasys, Inc.. which deposits a fine line of semi-molten polymer onto a substrate while moving via computer control to form the cross-sectional shape of the part it is building. The build platen is then lowered and the process is repeated, building a component directly layer by layer. This method enables direct net-shaped production of polymer components directly from a computer file. The layered manufacturing process allows for the manufacture of complex shapes and internal cavities otherwise impossible to machine. This task demonstrated the benefits of the FDM technique to quickly and inexpensively produce replacement components or repair broken hardware in a Space Shuttle or Space Station environment. The intent of the task was to develop and fabricate an FDM system that was lightweight, compact, and required minimum power consumption to fabricate ABS plastic hardware in

microgravity. The final product of the shortened task turned out to be a ground-based breadboard device, demonstrating miniaturization capability of the system.
Author
Microgravity; Deposition; Manufacturing; Numerical Control; Rapid Prototyping; Platens

20030067859 NASA Glenn Research Center, Cleveland, OH, USA
2001: A Space Odyssey Revisited: The Feasibility of 24 Hour Commuter Flights to the Moon Using NTR Propulsion with LUNOX Afterburners
Borowski, Stanley; Dudzinski, Leonard A.; June 2003; 26 pp.; In English; 33rd AIAA/ASME/SAE/ASEE Joint Propulsion Conference, 6-9 Jul. 1997, Seattle, WA, USA
Contract(s)/Grant(s): WU 953-20-0C
Report No.(s): NASA/TM-1998-208830/REV2; E-11441/REV2; NAS 1.15:208830/REV2; AIAA Paper 97-2956-Rev-2; No Copyright; Avail: CASI; A03, Hardcopy

The prospects for 24 hour commuter flights to the Moon, similar to that portrayed in 2001: A Space Odyssey but on a more Spartan scale, are examined using two near term, high leverage technologies: liquid oxygen (LOX)-augmented nuclear thermal rocket (NTR) propulsion and lunar-derived oxygen (LUNOX) production. Iron-rich volcanic glass, or orange soil, discovered during the Apollo 17 mission to Taurus-Littrow, has produced a 4 percent oxygen yield in recent NASA experiments using hydrogen reduction. LUNOX development and utilization would eliminate the need to transport oxygen supplies from Earth and is expected to dramatically reduce the size, cost and complexity of space transportation systems. The LOX-augmented NTR concept (LANTR) exploits the high performance capability of the conventional liquid hydrogen (LH2)-cooled NTR and the mission leverage provided by LUNOX in a unique way. LANTR utilizes the large divergent section of its nozzle as an afterburner into which oxygen is injected and supersonically combusted with nuclear preheated hydrogen emerging from the engine's choked sonic throat, essentially scramjet propulsion in reverse. By varying the oxygen-to-hydrogen mixture ratio, the LANTR engine can operate over a wide range of thrust and specific impulse (Isp) values while the reactor core power level remains relatively constant. The thrust augmentation feature of LANTR means that big engine performance can be obtained using smaller, more affordable, easier to test NTR engines. The use of high-density LOX in place of low density LH2 also reduces hydrogen mass and tank volume resulting in smaller space vehicles. An implementation strategy and evolutionary lunar mission architecture is outlined which requires only Shuttle C or in-line Shuttle-derived launch vehicles, and utilizes conventional NTR-powered lunar transfer vehicles (LTVs), operating in an expendable mode initially, to maximize delivered surface payload on each mission. The increased payload is dedicated to installing modular LUNOX production units with the intent of supplying LUNOX to lunar landing vehicles (LLVs) and then LTVs at the earliest possible opportunity. Once LUNOX becomes available in low lunar orbit (LLO), monopropellant NTRs would be outfitted with an oxygen propellant module, feed system and afterburner nozzle for bipropellant operation. Transition to a reusable mission architecture now occurs with smaller, LANTR-powered LTVs delivering ~400% more payload on each piloted round trip mission than earlier expendable all LH2 NTR systems. As initial lunar outposts grow to eventual lunar settlements and LUNOX production capacity increases, the LANTR concept can enable a rapid commuter shuttle capable of 24 hour one way trips to and from the Moon. A vast deposit of iron-rich volcanic glass beads identified at just one candidate site located at the southeastern edge of Mare Serenitatis could supply sufficient LUNOX to support daily commuter flights to the Moon for the next 9000 years!
Author
Space Transportation System; Shuttle Derived Vehicles; Liquid Rocket Propellants; Hydrogen Engines; Manned Space Flight; Lunar Landing

20030068062 Hernandez Engineering, Inc., USA
Fire In Space- What Do You Do?
Skinner, Keith; Emery, Melissa; June 2002; 12 pp.; In English; 20th Annual System Safety Society Conference, 5-9 Aug. 2002, Denver, CO, USA
Contract(s)/Grant(s): NAS8-00179; No Copyright; Avail: CASI; A03, Hardcopy

This paper addresses the process of performing detailed and thorough fire protection hazard analysis for the microgravity environment aboard the International Space Station (ISS).
Author
Fires; International Space Station; Microgravity; Space Flight

20030068508 NASA Johnson Space Center, Houston, TX, USA
STS-113 Mission Highlights Resource Tape Flight Days 4-6 Tape: 2 of 4
[2003]; In English; Tape: 2 of 4, 1 hr. 30 mins. playing time, in color with sound
Report No.(s): JSC1946; No Copyright; Avail: CASI; V04, Videotape-VHS; B04, Videotape-Beta

This video, Part 2 of 4, shows the activities of the crew of the Space Shuttle Endeavor on flight days 4-6 of STS-113. The crew consists of Commander Jim Wetherbee, Pilot Paul Lockhart, and Mission Specialists Michael Lopez-Alegria and John Herrington. On flight day 4, The P1 truss was transfered from Canadarm on Endeavour to Canadarm 2 on the ISS, and aligned with the S0 Truss for attachment. The mission specialists connected utility cables between the trusses on an extravehicular activity (EVA). Flight day 5 was Commander Wetherbee's 50th birthday, and the video includes a clip from The Tonight Show in which Jay Leno wishes him a happy birthday. Intravehicular activity on flight day 5 includes Peggy Whitsun of the outgoing Expedition 5 crew of the International Space Station (ISS) showing incoming Expedition 6 crew members Ken Bowersox and Don Pettit how to replace valves on the ISS CO2 removal system. The video also includes an interior tour of Endeavour and the ISS, and an brief exterior tour of the ISS. On flight day 6 Lopez-Alegria and Herrington attach a television antenna to the P1 truss, and are shown using a handcart on the truss several times. The video includes several Earth views, including one of the west coast of South America.
CASI
Endeavour (Orbiter); International Space Station; Extravehicular Activity; Spacecrews; Orbital Assembly

20030068509 NASA Kennedy Space Center, Cocoa Beach, FL, USA
STS-105/Discovery/ISS 7A.1: Pre-Launch Activities, Launch, Orbit Activities and Landing
August 10, 2001; In English; 60 Mins. playing time, in color, with sound; No Copyright; Avail: CASI; V03, Videotape-VHS; B03, Videotape-Beta

The crew of Space Shuttle Discovery on STS-105 is introduced at their pre-launch meal and at suit-up. The crew members include Commander Scott Horowitz, Pilot Rick Sturckow, and Mission Specialists Patrick Forrester and Daniel Barry, together with the Expedition 3 crew of the International Space Station (ISS). The Expedition 3 crew includes Commander Frank Culbertson, Soyuz Commander Vladimir Dezhurov, and Flight Engineer Mikhail Tyurin. When the astronauts depart for the launch pad in the Astrovan, their convoy is shown from above. Upon reaching the launch pad, they conduct a walk around of the shuttle, display signs for family members while being inspected in the White Room, and are strapped into their seats onboard Disciovery. The video includes footage of Discovery in the Orbiter Processing Facility, and some of the pre-launch procedures at the Launch Control Center are shown. The angles of launch replays include: TV-1, Beach Tracker, VAB, Pad A, Tower 1, UCS-15, Grandstand, OTV-70, Onboard, IGOR, and UCS-23. The moment of docking between Discovery and the ISS is shown from inside Discovery's cabin. While in orbit, the crew conducted extravehicular activities (EVAs) to attach an experiments container, and install handrails on the Destiny module of the ISS. The video shows the docking and unloading of the Leonardo Multipurpose Logistics Module (MPLM) onto the ISS. The deployment of a satellite from Discovery with the coast of the Gulf of Mexico in the background is shown. Cape Canaveral is also shown from space. Landing replays include VAB, Tower 1, mid-field, South End SLF, North End SLF, Tower 2, Playalinda DOAMS, UCS-23, and Pilot Point of View (PPOV). NASA Administrator Dan Goldin meets the crew upon landing and participates in their walk around of Discovery. The video concludes with a short speech by commander Horowitz.
CASI
Discovery (Orbiter); International Space Station; Spacecrews; Spacecraft Launching; Horizontal Spacecraft Landing; Preflight Operations

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*.

20030067746 Joint Chiefs of Staff, Washington, DC
2003 CJCS Master Positioning, Navigation, and Timing Plan
Mar. 31, 2003; 84 pp.; In English
Report No.(s): AD-A414737; CJCSI-6130.01C; No Copyright; Avail: CASI; A05, Hardcopy

This Instruction constitutes the Department of Defense (DoD) plan for use, sustainment, and modernization of positioning, navigation, and timing (PNT) systems to meet operational requirements. The Instruction supercedes CJCSI 6130.

01B, 15 June 2000, '2000 CJCS Master Positioning, Navigation, and Timing Plan (MPNTP).' The Instruction has been updated to reflect the merger of the U.S. Strategic Command (USSTRATCOM) and U.S. Space Command (USSPACECOM). Effective 1 October 2002, these organizations officially merged and retain the name USSTRATCOM. The Instruction also reflects new GPS user equipment acquisition policy and updates to the current PNT architecture and PNT research and development. GPS is now and will continue to be the primary radionavigation system source of PNT information for the Department of Defense. All DoD combatant users must acquire, train with, and use GPS systems capable of receiving the encrypted, military GPS signal, the Precise Positioning Service (PPS). The following enclosures are included in this Instruction: (A) positioning, Navigation, and Timing Policy; (B) Positioning, Navigation, and Timing Requirements; (C) Positioning, Navigation, and Timing System Architecture; (D) GPS Operations and Security Policy; (E) GPS User Equipment Acquisition Policy and Status; (F) Operational PNT Systems -- Descriptions and Characteristics; (G) Positioning, Navigation, and Timing Research and Development; (H) Control of PNT Systems in Times of Tension or War; (I) geospatial Information and Services; (J) Precise Time and Time Interval; (K) references; and (L) Glossary. (11 refs.)
DTIC
Global Positioning System; Defense Program; Information Systems; Radio Navigation

20030067897 Lockheed Martin Space Systems Co., Huntsville, AL, USA
Universal Payload Information Management
Elmore, Ralph B.; [2003]; 44 pp.; In English; AIAA SpaceOps 2002 Conference, 9-12 Oct. 2002, Houston, TX, USA; No Copyright; Avail: CASI; A03, Hardcopy

As the overall manager and integrator of International Space Station (ISS) science payloads, the Payload Operations Integration Center (POIC) at Marshall Space Flight Center has a critical need to provide an information management system for exchange and control of ISS payload files as well as to coordinate ISS payload related operational changes. The POIC's information management system has a fundamental requirement to provide secure operational access not only to users physically located at the POIC, but also to remote experimenters and International Partners physically located in different parts of the world. The Payload Information Management System (PIMS) is a ground-based electronic document configuration management and collaborative workflow system that was built to service the POIC's information management needs. This paper discusses the application components that comprise the PIMS system, the challenges that influenced its design and architecture, and the selected technologies it employs. This paper will also touch on the advantages of the architecture, details of the user interface, and lessons learned along the way to a successful deployment. With PIMS, a sophisticated software solution has been built that is not only universally accessible for POIC customer s information management needs, but also universally adaptable in implementation and application as a generalized information management system.
Author
Information Management; Payload Integration; Space Station Payloads; Configuration Management

20030068235 NASA Marshall Space Flight Center, Huntsville, AL, USA
Space-based Operations Grid Prototype
Bradford, Robert N.; Welch, Clara L.; [2003]; 1 pp.; In English; Mission Systems 2003: Control Center Technologies in the Third International Conference for Tech Operations, 12-15 Aug. 2003, Houston, TX, USA; No Copyright; Avail: Other Sources; Abstract Only

The Space based Operations Grid is intended to integrate the 'high end' network services and compute resources that a remote payload investigator needs. This includes integrating and enhancing existing services such as access to telemetry, payload commanding, payload planning and internet voice distribution as well as the addition of services such as video conferencing, collaborative design, modeling or visualization, text messaging, application sharing, and access to existing compute or data grids. Grid technology addresses some of the greatest challenges and opportunities presented by the current trends in technology, i.e. how to take advantage of ever increasing bandwidth, how to manage virtual organizations and how to deal with the increasing threats to information technology security. We will discuss the pros and cons of using grid technology in space-based operations and share current plans for the prototype. It is hoped that early on the prototype can incorporate many of the existing as well as future services that are discussed in the first paragraph above to cooperating International Space Station Principle Investigators both nationally and internationally.
Author
Information Systems; Teleconferencing; Video Communication; Video Conferencing; Telemetry

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*.

20030067852 Johns Hopkins Univ., Laurel, MD, USA
2D and 3D Method of Characteristic Tools for Complex Nozzle Development
Rice, Tharen; June 30, 2003; 42 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): NAG3-2460
Report No.(s): RTDC-TPS-481; No Copyright; Avail: CASI; A03, Hardcopy

This report details the development of a 2D and 3D Method of Characteristic (MOC) tool for the design of complex nozzle geometries. These tools are GUI driven and can be run on most Windows-based platforms. The report provides a user's manual for these tools as well as explains the mathematical algorithms used in the MOC solutions.
Derived from text
Nozzle Geometry; Three Dimensional Models; Nozzle Design; Supersonic Combustion Ramjet Engines; Methodology

20030067885 NASA Marshall Space Flight Center, Huntsville, AL, USA
NASA's Orbital Space Plane Risk Reduction Strategy
Dumbacher, Dan; [2003]; 9 pp.; In English; AIAA/ICAS International Air and Space Symposium and Exposition: The Next 100 Years, 14-17 Jul. 2003, Dayton, OH, USA
Report No.(s): AIAA Paper 2003-3332; Copyright; Avail: CASI; A02, Hardcopy

This paper documents the transformation of NASA s Space Launch Initiative (SLI) Second Generation Reusable Launch Vehicle Program under the revised Integrated Space Transportation Plan, announced November 2002. Outlining the technology development approach followed by the original SLI, this paper gives insight into the current risk-reduction strategy that will enable confident development of the Nation s first orbital space plane (OSP). The OSP will perform an astronaut and contingency cargo transportation function, with an early crew rescue capability, thus enabling increased crew size and enhanced science operations aboard the International Space Station. The OSP design chosen for full-scale development will take advantage of the latest innovations American industry has to offer. The OSP Program identifies critical technologies that must be advanced to field a safe, reliable, affordable space transportation system for U.S. access to the Station and low-Earth orbit. OSP flight demonstrators will test crew safety features, validate autonomous operations, and mature thermal protection systems. Additional enabling technologies may be identified during the OSP design process as part of an overall risk-management strategy. The OSP Program uses a comprehensive and evolutionary systems acquisition approach, while applying appropriate lessons learned.
Author
Risk; NASA Space Programs; Aerospace Planes; Reusable Launch Vehicles; Autonomy; Orbital Maneuvering Vehicles

20030067928 NASA Glenn Research Center, Cleveland, OH, USA
An Updated Zero Boil-Off Cryogenic Propellant Storage Analysis Applied to Upper Stages or Depots in a LEO Environment
Plachta, David; Kittel, Peter; June 2003; 13 pp.; In English; 38th AIAA/ASME/SAE/ASEE Joint Propulsion Conference and Exhibit, 7-10 Jul. 2002, Indianapolis, IN, USA
Contract(s)/Grant(s): WU 706-87-13
Report No.(s): NASA/TM-2003-211691; E-13421; NAS 1.15:211691; AIAA Paper 2002-3589; No Copyright; Avail: CASI; A03, Hardcopy

Previous efforts have shown the analytical benefits of zero boil-off (ZBO) cryogenic propellant storage in launch vehicle upper stages of Mars transfer vehicles for conceptual Mars Missions. However, recent NASA mission investigations have looked at a different and broad array of missions, including a variety of orbit transfer vehicle (OTV) propulsion concepts, some requiring cryogenic storage. For many of the missions, this vehicle will remain for long periods (greater than one week) in low earth orbit (LEO), a relatively warm thermal environment. Under this environment, and with an array of tank sizes and propellants, the performance of a ZBO cryogenic storage system is predicted and compared with a traditional, passive-only storage concept. The results show mass savings over traditional, passive-only cryogenic storage when mission durations are

less than one week in LEO for oxygen, two weeks for methane, and roughly 2 months for LH2. Cryogenic xenon saves mass over passive storage almost immediately.
Author
Cryogenics; Propellant Storage; Mars Missions; Orbit Transfer Vehicles; Low Earth Orbits

20030067947 Lockheed Martin Astronautics, Denver, CO, USA
Selection of Lockheed Martin's Preferred TSTO Configurations for the Space Launch Initiative
Hopkins, Joshua B.; [2002]; 7 pp.; In English; 2002 World Space Congress (IAF/COSPAR/AIAA), 10-19 Oct. 2002, Houston, TX, USA
Contract(s)/Grant(s): NAS8-01098
Report No.(s): IAC-02-V.4.03; Copyright; Avail: CASI; A02, Hardcopy

Lockheed Martin is developing concepts for safe, affordable Two Stage to Orbit (TSTO) reusable launch vehicles as part of NASA s Space Launch Initiaiive. This paper discusses the options considered for the design of the TSTO, the impact of each of these options on the vehicle configuration, the criteria used for selection of preferred configurations, and the results of the selection process. More than twenty configurations were developed in detail in order to compare optioiis such as propellant choice, serial vs. parallel burn sequence, use of propellant crossfeed between stages, bimese or optimized stage designs, and high or low staging velocities. Each configuration was analyzed not only for performance and sizing, but also for cost and reliability. The study concluded that kerosene was the superior fuel for first stages, and that bimese vehicles were not attractive.
Author
Spacecraft Launching; Reusable Launch Vehicles; Spacecraft Configurations; Astronautics; Spacecraft Design; NASA Programs

20030068113 NASA Langley Research Center, Hampton, VA, USA
Low Cost Mars Surface Exploration: The Mars Tumbleweed
Antol, Jeffrey; Calhoun, Philip; Flick, John; Hajos, Gregory; Kolacinski, Richard; Minton, David; Owens, Rachel; Parker, Jennifer; August 1, 2003; 43 pp.; In English
Contract(s)/Grant(s): WU 274-00-03-36
Report No.(s): NASA/TM-2003-212411; L-18275; NAS 1.15:212411; No Copyright; Avail: CASI; A03, Hardcopy

The 'Mars Tumbleweed,' a rover concept that would utilize surface winds for mobility, is being examined as a low cost complement to the current Mars exploration efforts. Tumbleweeds carrying microinstruments would be driven across the Martian landscape by wind, searching for areas of scientific interest. These rovers, relatively simple, inexpensive, and deployed in large numbers to maximize coverage of the Martian surface, would provide a broad scouting capability to identify specific sites for exploration by more complex rover and lander missions.
Author
Low Cost; Mars Exploration; Mars Surface; Mars Missions; Mars Roving Vehicles; Mathematical Models

20030068153 NASA Marshall Space Flight Center, Huntsville, AL, USA
A Sterile Robotic Mars Soil Analyzer
Levin, Gilbert V.; Miller, Joseph D.; Straat, Patricia Ann; Hoover, Richard E.; [2002]; 1 pp.; In English; SPIE Instruments, Methods, and Missions for Astrobiology, 22-23 Aug. 2002, Waikoloa, HI, USA; Copyright; Avail: CASI; A01, Hardcopy

Since the 1976 Viking Mission to Mars, follow-on efforts to resolve its controversial life detection results have been thwarted by two heretofore insurmountable difficulties: the huge expense of sterilizing the entire spacecraft to protect the integrity of life detection experiments; and the lack of a practical robotic life detection package that could produce results acceptable as unambiguous by the scientific community. We here present a method that assures sterility and the complete integrity of robotic life detection experiments, all at a negligible cost. Second, we propose a candidate set of integrated, highly sensitive experiments that we believe could produce results acceptable to the vast majority of scientists. In addition to the biology-chemistry issue, the extensively debated oxidative state of the Martian surface and other chemical and physical characteristics of the Martian soil would be determined. We present our concept for a miniaturized instrument that could carry out a number of candidate experiments to achieve the objective.
Author
Robotics; Soils; Miniaturization; Mars Surface

20030068420 NASA Marshall Space Flight Center, Huntsville, AL, USA

International Space Station Internal Thermal Control System Cold Plate/Fluid-Stability Test: Two Year Update

Wieland, Paul; Holt, Mike; Roman, Monsi; Cole, Harold; Daugherty, Steve; [2003]; 8 pp.; In English; 33rd International Conference on Environmental Systems, 7-10 Jul. 2003, Vancouver, BC, Canada

Contract(s)/Grant(s): RTOP 336-33-30

Report No.(s): SAE Paper-2003-01-2518; Copyright; Avail: CASI; A02, Hardcopy

Operation of the Internal Thermal Control System (ITCS) Cold Plate/Fluid-Stability Test Facility commenced on September 5, 2000. The facility was intended to provide advance indication of potential problems on board the International Space Station (ISS) and was designed: 1) To be materially similar to the flight ITCS. 2) To allow for monitoring during operation. 3) To run continuously for three years. During the first two years of operation the conditions of the coolant and components were remarkably stable. During this same period of time, the conditions of the ISS ITCS significantly diverged from the desired state. Due to this divergence, the test facility has not been providing information useful for predicting the flight ITCS condition. Results of the first two years are compared with flight conditions over the same time period, showing the similarities and divergences. To address the divergences, the test facility was modified incrementally to more closely match the flight conditions, and to gain insight into the reasons for the divergence. Results of these incremental changes are discussed and provide insight into the development of the conditions on orbit.

Author

International Space Station; Temperature Control; Test Facilities

20030068423 NASA Johnson Space Center, Houston, TX, USA

Meteoroid/Debris Shielding

Christiansen, Eric L.; August 2003; 111 pp.; In English; Original contains color and black and white illustrations

Report No.(s): NASA/TP-2003-210788; S-898; NAS 1.60:210788; No Copyright; Avail: CASI; A06, Hardcopy

This report provides innovative, low-weight shielding solutions for spacecraft and the ballistic limit equations that define the shield's performance in the meteoroid/debris environment. Analyses and hypervelocity impact testing results are described that have been used in developing the shields and equations. Spacecraft shielding design and operational practices described in this report are used to provide effective spacecraft protection from meteoroid and debris impacts. Specific shield applications for the International Space Station (ISS), Space Shuttle Orbiter and the CONTOUR (Comet Nucleus Tour) space probe are provided. Whipple, Multi-Shock and Stuffed Whipple shield applications are described.

Author

Meteorite Collisions; Impact Tests; Spacecraft Shielding; Space Debris; Hypervelocity Impact

20030068741 Pratt and Whitney Space Propulsion, West Palm, FL, USA

Design Considerations of Istar Hydrocarbon Fueled Combustor Operating in Air Augmented Rocket, Ramjet and Scramjet Modes

Andreadis, Dean; Drake, Alan; Garrett, Joseph L.; Gettinger, Christopher D.; Hoxie, Stephen S.; September 29, 2002; 11 pp.; In English; 11th AIAA/AAF International Conference on Space Planes and Hypersonic Systems and Technologies, 29 Sep. - 4 Oct. 2002, Orleans, France

Contract(s)/Grant(s): NAS8-02001; No Copyright; Avail: CASI; A03, Hardcopy

The development and ground test of a rocket-based combined cycle (RBCC) propulsion system is being conducted as part of the NASA Marshall Space Flight Center (MSFC) Integrated System Test of an Airbreathing Rocket (ISTAR) program. The eventual flight vehicle (X-43B) is designed to support an air-launched self-powered Mach 0.7 to 7.0 demonstration of an RBCC engine through all of its airbreathing propulsion modes - air augmented rocket (AAR), ramjet (RJ), and scramjet (SJ). Through the use of analytical tools, numerical simulations, and experimental tests the ISTAR program is developing and validating a hydrocarbon-fueled RBCC combustor design methodology. This methodology will then be used to design an integrated RBCC propulsion system thai: produces robust ignition and combustion stability characteristics while maximizing combustion efficiency and minimizing drag losses. First order analytical and numerical methods used to design hydrocarbon-fueled combustors are discussed with emphasis on the methods and determination of requirements necessary to establish engine operability and performance characteristics.

Author

Combustion Chambers; Rocket-Based Combined-Cycle Engines; Supersonic Combustion Ramjet Engines; Hydrocarbon Fuels; Ramjet Engines

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SPACECRAFT INSTRUMENTATION AND ASTRIONICS

Includes the design, manufacture, or use of devices for the purpose of measuring, detecting, controlling, computing, recording, or processing data related to the operation of space vehicles or platforms. For related information see also *06 Avionics and Aircraft Instrumentation*; for spaceborne instruments not integral to the vehicle itself see *35 Instrumentation and Photography*; for spaceborne telescopes and other astronomical instruments see *89 Astronomy*.

20030068239 Iowa State Univ. of Science and Technology, Ames, IA, USA

On-Board Entry Trajectory Planning Expanded to Sub-orbital Flight

Lu, Ping; Shen, Zuojun; January 15, 2003; 30 pp.; In English; AIAA Guidance, Navigation, and Control Conference, 11-14 Aug. 2003, Austin, TX

Contract(s)/Grant(s): NAS8-01105; NAG8-1637; Copyright; Avail: CASI; A03, Hardcopy

A methodology for on-board planning of sub-orbital entry trajectories is developed. The algorithm is able to generate in a time frame consistent with on-board environment a three-degree-of-freedom (3DOF) feasible entry trajectory, given the boundary conditions and vehicle modeling. This trajectory is then tracked by feedback guidance laws which issue guidance commands. The current trajectory planning algorithm complements the recently developed method for on-board 3DOF entry trajectory generation for orbital missions, and provides full-envelope autonomous adaptive entry guidance capability. The algorithm is validated and verified by extensive high fidelity simulations using a sub-orbital reusable launch vehicle model and difficult mission scenarios including failures and aborts.

Author

Reusable Launch Vehicles; Trajectory Planning; Boundary Conditions; Algorithms

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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*.

20030067697 Colorado State Univ., Fort Collins, CO, USA

Numerical Simulation of Ion Thruster Optics

Rawlin, Vincent K., Technical Monitor; Farnell, Cody C.; Williams, John D.; Wilbur, Paul J.; July 2003; 16 pp.; In English; 28th International Electric Propulsion Conference, 17-21 Mar. 2003, Toulouse, France; Original contains color illustrations

Contract(s)/Grant(s): NAG3-1801; WBS 22-800-50-01

Report No.(s): NASA/CR-2003-212305; E-13882; NAS 1.26:212305; No Copyright; Avail: CASI; A03, Hardcopy

A three-dimensional simulation code (ffx) designed to analyze ion thruster optics is described. It is an extension of an earlier code and includes special features like the ability to model a wide range of grid geometries, cusp details, and mis-aligned aperture pairs to name a few. However, the principle reason for advancing the code was in the study of ion optics erosion. Ground based testing of ion thruster optics, essential to the understanding of the processes of grid erosion, can be time consuming and costly. Simulation codes that can accurately predict grid lifetimes and the physical mechanisms of grid erosion can be of great utility in the development of future ion thruster optics designed for more ambitious applications. Results of simulations are presented that describe wear profiles for several standard and nonstandard aperture geometries, such as those grid sets with square- or slotted-hole layout patterns. The goal of this paper will be to introduce the methods employed in the ffx code and to briefly demonstrate their use.

Author

Computerized Simulation; Ion Optics; Three Dimensional Models; Thrustors; Numerical Analysis

20030067733 NASA Marshall Space Flight Center, Huntsville, AL, USA

Evaluation and Characterization Study of Dual Pulse Laser-Induced Spark (DPLIS) for Rocket Engine Ignition System Application

Osborne, Robin; Wehrmeyer, Joseph; Trinh, Huu; Early, James; July 07, 2003; 7 pp.; In English; 39th AIAA/ASME/SAE/ASEE Joint Propulsion Conference and Exhibit, 20-23 Jul. 2003, Huntsville, AL, USA; Original contains black and white illustrations; Copyright; Avail: CASI; A02, Hardcopy

This paper addresses the progress of technology development of a laser ignition system at NASA Marshall Space Flight Center (MSFC). Laser ignition has been used at MSFC in recent test series to successfully ignite RP1/GOX propellants in a

subscale rocket chamber, and other past studies by NASA GRC have demonstrated the use of laser ignition for rocket engines. Despite the progress made in the study of this ignition method, the logistics of depositing laser sparks inside a rocket chamber have prohibited its use. However, recent advances in laser designs, the use of fiber optics, and studies of multi-pulse laser formats3 have renewed the interest of rocket designers in this state-of the-art technology which offers the potential elimination of torch igniter systems and their associated mechanical parts, as well as toxic hypergolic ignition systems. In support of this interest to develop an alternative ignition system that meets the risk-reduction demands of Next Generation Launch Technology (NGLT), characterization studies of a dual pulse laser format for laser-induced spark ignition are underway at MSFC. Results obtained at MSFC indicate that a dual pulse format can produce plasmas that absorb the laser energy as efficiently as a single pulse format, yet provide a longer plasma lifetime. In an experiments with lean H2/air propellants, the dual pulse laser format, containing the same total energy of a single laser pulse, produced a spark that was superior in its ability to provide sustained ignition of fuel-lean H2/air propellants. The results from these experiments are being used to optimize a dual pulse laser format for future subscale rocket chamber tests. Besides the ignition enhancement, the dual pulse technique provides a practical way to distribute and deliver laser light to the combustion chamber, an important consideration given the limitation of peak power that can be delivered through optical fibers. With this knowledge, scientists and engineers at Los Alamos National Laboratory and CFD Research Corporation have designed and fabricated a miniaturized, first-generation optical prototype of a laser ignition system that could be the basis for a laser ignition system for rocket applications. This prototype will be tested at MSFC in future subscale rocket ignition tests.
Author
Computational Fluid Dynamics; Ignition Systems; Pulsed Lasers; Rocket Engines; Laser Outputs; Spark Ignition; Fabrication

20030067740 NASA Marshall Space Flight Center, Huntsville, AL, USA
The Case of Nuclear Propulsion
Koroteev, Anatoly S.; Ponomarev-Stepnoi, Nicolai N.; Smetannikov, Vladimir P.; Gafarov, Albert A.; Houts, Mike; VanDyke, Melissa; Godfroy, Tom; Martin, James; Bragg-Sitton, Shannon; Dickens, Ricky, et al.; [2003]; 10 pp.; In English; International Air and Space Symposium, 13-17 Jul. 2003, Dayton, OH, USA; Copyright; Avail: CASI; A02, Hardcopy

Fission technology can enable rapid, affordable access to any point in the solar system. If fission propulsion systems are to be developed to their full potential; however, near-term customers must be identified and initial fission systems successfully developed, launched, and utilized. Successful utilization will simultaneously develop the infrastructure and experience necessary for developing even higher power and performance systems. To be successful, development programs must devise strategies for rapidly converting paper reactor concepts into actual flight hardware. One approach to accomplishing this is to design highly testable systems, and to structure the program to contain frequent, significant hardware milestones. This paper discusses ongoing efforts in Russia and the USA aimed at enabling near-term utilization of space fission systems.
Author
Nuclear Electric Propulsion; Propulsion System Configurations; Aerospace Systems; Nuclear Rocket Engines; NASA Space Programs

20030067777 AIR FORCE RESEARCH LAB. EDWARDS AFB CA, Edwards AFB, CA, USA
Arcjet Plasma Neutralization of Hall Thrusters I: Hybrid Thruster Mission Analysis
Hargus, William A.; Schilling, John H.; Walker, Quinten E.; Cappelli, Mark A.; Mar. 10, 2003; 25 pp.; In English
Contract(s)/Grant(s): Proj-1011
Report No.(s): AD-A414751; AFRL-PR-ED-TP-2003-060; No Copyright; Avail: CASI; A03, Hardcopy

Clustering multiple thrusters has emerged as a favored option for extending Hall effect thruster propulsion to very high powers (100-150 kW) for a variety of Air Force missions. However, there are inherent difficulties in the simultaneous neutralization of several Hall effect thrusters. Chief among these is the issue of unequal current sharing among multiple cathodes. For this reason, it may prove advantageous to use a single, high current neutralizer. Conventional Hall effect thruster neutralizers, hollow cathodes, typically consume 10% of the propellant flow and produce little or no thrust. An arcjet is an electro-thermal electric thruster with moderate efficiency and specific impulse ranges. It is also a high plasma density device that is capable of supporting and amplifying electron current through volume ionization and is capable of neutralizing single or clusters of Hall effect thrusters. By using an arcjet as a neutralizer, Hall effect thrusters will also produce useful thrust from their neutralizers. Because of the arcjet's lower specific impulse, the hybrid arcjet-Hall system will have a lower specific impulse than that of a pure Hall effect system. However by choosing suitable propellants, the hybrid Hall cluster will retain the high thrust efficiencies typical of pure Hall effect systems with the added benefit of lower total wet mass for select missions due to a higher system thrust density. This work examines the application of an arcjet-neutralized cluster of Hall effect thrusters for a low earth orbit to geosynchronous orbit transfer. The analysis shows that hybrid Hall effect clusters neutralized

by a single medium power arcjet are advantageous for some orbit raising missions. Helium arcjet-neutralizers coupled with conventional xenon Hall effect anodes appear to he the superior configuration due to their relatively high efficiencies and low tankage fractions when compared to alternative propellant mixes.
DTIC
Hall Effect; Hall Thrusters; Clusters

20030067827 AIR FORCE RESEARCH LAB. EDWARDS AFB CA, Edwards AFB, CA, USA
The Impact of Modeling Fidelity on Rocket Engine Performance Parameters
Archambault, Mark; Apr. 29, 2003; 6 pp.; In English
Contract(s)/Grant(s): Proj-3058
Report No.(s): AD-A414793; AFRL-PR-ED-AB-2003-112; No Copyright; Avail: CASI; A02, Hardcopy

The overall objective of this research is to establish a design methodology for gas/gas injectors. This paper, however, focuses on a computational methodology to efficiently, accurately, and robustly obtain high-fidelity solutions of combusting rocket engine flows to gain a knowledge and understanding of their features. To that end, simulations of a single-element, shear-coaxial, H2/O2 engine are being performed to characterize its flowfield and to validate the CFD++ flow solver for this class of problems. previous work has focused on obtaining solutions on a grid three to four times finer than those reported by other researchers and resolving numerical issues that reduce the computational efficiency of this inherently unsteady flow. Comparisons of two-dimensional and three-dimensional steady and averaged time-accurate solutions have also shown that a steady solution may not provide an accurate depiction of the combusting flow field over time. Other simulations have shown that flow features unique to an experimental configuration, such as a nitrogen curtain purge used to cool the optical access, can influence both the experimental and computational results. Figure 2 shows that when the nitrogen curtain purge present in the experiment is modeled, the predicted hydrogen profile is more consistent with the experimental data. This is due to the fact that when the nitrogen is present, the hydrogen is unable to radially diffuse to the engine walls as quickly as when the nitrogen is absent. It is clear that the nitrogen has had an influence on the experimental data and both the experimenter and the modeler should take care when interpreting their results. The converging section of the nozzle and the throat were omitted in these previous studies while numerical issues associated with the calculations were resolved and because the region of interest was far upstream of the outlet.
DTIC
Performance Prediction; Injectors; Rocket Engines

20030067853 NASA Marshall Space Flight Center, Huntsville, AL, USA
A Plasmoid Thruster for Space Propulsion
Koelfgen, Syri J.; Hawk, Clark W.; Eskridge, Richard; Smith, James W.; Martin, Adam K.; [2003]; 21 pp.; In English; 39th AIAA/ASME/SAE/ASEE Joint Propulsion Conference and Exhibition, 20-23 Jul. 2003, Huntsville, AL, USA
Report No.(s): AIAA Paper 2001-3671; No Copyright; Avail: CASI; A03, Hardcopy

There are a number of possible advantages to using accelerated plasmoids for in-space propulsion. A plasmoid is a compact plasma structure with an integral magnetic field. They have been studied extensively in controlled fusion research and are classified according to the relative strength of the poloidal and toroidal magnetic field (B(sub p), and B(sub t), respectively). An object with B(sub p), / B(sub t) much greater than 1 is classified as a Field Reversed Configuration (FRC); if B(sub p) approximately equal to B(sub t), it is called a Spheromak. The plasmoid thruster operates by producing FRC-like plasmoids and subsequently ejecting them from the device at a high velocity. The plasmoid is formed inside of a single-turn conical theta-pinch coil. As this process is inductive, there are no electrodes. Similar experiments have yielded plasmoid velocities of at least 50 km/s, and calculations indicate that velocities in excess of 100 km/s should be possible. This concept should be capable of producing Isp's in the range of 5,000 - 15,000 s with thrust densities on the order of 10(exp 5) N per square meters. The current experiment is designed to produce jet powers in the range of 5 - 10 kW, although the concept should be scalable to several MW's. The plasmoid mass and velocity will be measured with a variety of diagnostics, including internal and external B-dot probes, flux loops, Langmuir probes, high-speed cameras and a laser interferometer. Also of key importance will be measurements of the efficiency and mass utilization. Simulations of the plasmoid thruster using MOQUI, a time-dependent MHD code, will be carried out concurrently with experimental testing.
Author
Plasmas (Physics); Thrust; Magnetohydrodynamics; Spacecraft Propulsion; Electrostatic Probes; Magnetic Fields

20030067926 Pratt and Whitney Space Propulsion, West Palm Beach, FL, USA

Design Considerations of ISTAR Hydrocarbon Fueled Combustor Operating in Air Augmented Rocket, Ramjet and Scramjet Modes

Andreadis, Dean; Drake, Alan; Garrett, Joseph L.; Gettinger, Christopher D.; Hoxie, Stephen S.; [2003]; 11 pp.; In English Contract(s)/Grant(s): NAS8-02001; No Copyright; Avail: CASI; A03, Hardcopy

The development and ground test of a rocket-based combined cycle (RBCC) propulsion system is being conducted as part of the NASA Marshall Space Flight Center (MSFC) Integrated System Test of an Airbreathing Rocket (ISTAR) program. The eventual flight vehicle (X-43B) is designed to support an air-launched self-powered Mach 0.7 to 7.0 demonstration of an RBCC engine through all of its airbreathing propulsion modes - air augmented rocket (AAR), ramjet (RJ), and scramjet (SJ). Through the use of analytical tools, numerical simulations, and experimental tests the ISTAR program is developing and validating a hydrocarbon-fueled RBCC combustor design methodology. This methodology will then be used to design an integrated RBCC propulsion system that produces robust ignition and combustion stability characteristics while maximizing combustion efficiency and minimizing drag losses. First order analytical and numerical methods used to design hydrocarbon-fueled combustors are discussed with emphasis on the methods and determination of requirements necessary to establish engine operability and performance characteristics.

Author

Rocket-Based Combined-Cycle Engines; Combustion Efficiency; Ramjet Engines

20030068275 Swedish Defence Research Establishment, Tumba

Dynamic Testing Device for Testing of the Booster Motor in MBT LAW

Appelgren, P.; Apr. 2002; In Swedish

Report No.(s): PB2003-103258; FOI-R-0470-SE; No Copyright; Avail: National Technical Information Service (NTIS)

Saab Bofors Dynamics commissioned FOI to build a dynamic testing device to measure the momentum caused by misalignment of the axial thrust force of a rocket. The dynamic testing device consists of a steel disc with a 30 mm wide groove. This 1.30 mm thick membrane rests on a liquid and on the membrane surface strain gauges are glued. The motor type tested has a thrust force of 20 kN and a burning time of 20 ms.

NTIS

Booster Rocket Engines; Dynamic Tests; Burning Time

20030068298 ATK-Thiokol Propulsion, Brigham City, UT, USA

Real-Time Inhibitor Recession Measurements in Two Space Shuttle Reusable Solid Rocket Motors

McWhorter, B. B.; Ewing, M. E.; Bolton, D. E.; Albrechtsen, K. U.; Earnest, T. E.; Noble, T. C.; Longaker, M.; [2003]; 10 pp.; In English; 39th AIAA/ASME/SAE/ASEE Joint Propulsion Conference, 20-23 Jul. 2003, Huntsville, AL, USA

Contract(s)/Grant(s): NAS8-97238

Report No.(s): AIAA Paper 2003-5108; Copyright; Avail: CASI; A02, Hardcopy

Real-time internal motor insulation char line recession measurements have been evaluated for two full-scale static tests of the Space Shuttle Reusable Solid Rocket Motor (RSRM). These char line recession measurements were recorded on the forward facing propellant grain inhibitors to better understand the thermal performance of these inhibitors. The RSRM propellant grain inhibitors are designed to erode away during motor operation, thus making it difficult to use post-fire observations to determine inhibitor thermal performance. Therefore, this new internal motor instrumentation is invaluable in establishing an accurate understanding of inhibitor recession versus motor operation time. The data for the first test was presented at the 37th AIAA/ASME/SAE/ASEE Joint Propulsion Conference and Exhibit (AIAA 2001-3280) in July 2001. Since that time, a second full scale static test has delivered additional real-time data on inhibitor thermal performance. The evaluation of this data is presented in this paper. The second static test, in contrast to the first test, used a slightly different arrangement of instrumentation in the inhibitors. This instrumentation has yielded a better understanding of the inhibitor time dependent inboard tip recession. Graphs of inhibitor recession profiles with time are presented. Inhibitor thermal ablation models have been created from theoretical principals. The model predictions compare favorably with data from both tests. This verified modeling effort is important to support new inhibitor designs for a five segment Space Shuttle solid rocket motor. The internal instrumentation project on RSRM static tests is providing unique opportunities for other real-time internal motor measurements that could not otherwise be directly quantified.

Author

Space Shuttle Boosters; Propellant Grains; Inhibitors; Engine Tests; In-Flight Monitoring

20030068300 NASA Marshall Space Flight Center, Huntsville, AL, USA
Combination Solar Sail and Electrodynamic Tether Propulsion System
Johnson, Charles L., Inventor; Matloff, Gregory L., Inventor; May 20, 2003; 8 pp.; In English
Patent Info.: Filed 14 Mar. 2002; US-Patent-6,565,044; US-Patent-Appl-SN-097698; NASA-Case-MFS-31503; No Copyright; Avail: CASI; A02, Hardcopy

A propulsion system for a spacecraft includes a solar sail system and an electrodynamic tether system is presented. The solar sail system is used to generate propulsion to propel the spacecraft through space using solar photons and the electrodynamic tether system is used to generate propulsion to steer the spacecraft into orbit and to perform orbital maneuvers around a planet using the planet's magnetic field. The electrodynamic tether system can also be used to generate power for the spacecraft using the planet's magnetic field.
Official Gazette of the U.S. Patent and Trademark Office
Solar Sails; Tethering; Electrodynamics; Spacecraft Propulsion; Propulsion System Configurations

20030068323 Air Force Research Lab., Edwards AFB, CA, USA, NASA Glenn Research Center, Cleveland, OH, USA
Preliminary Performance Results of the High Performance Hall System SPT-140
Hargus, William, Jr.; Fife, J. M.; Mason, Lee; Jankovsky, Robert; Haag, Thomas; June 19, 2000; 14 pp.; In English
Contract(s)/Grant(s): F04611-97-C-0064; AF Proj. 4373
Report No.(s): AD-A410394; AFRL-PR-ED-TP-2000-137; No Copyright; Avail: CASI; A03, Hardcopy

The High Performance Hall System (HPHS) program supports the development and flight qualification of a 4.5 kW electric propulsion system that includes the SPT-140 Hall thruster. The Air Force Research Laboratory (AFRL) and International Space Technology, Inc. (ISTI) are co-funding the HPHS program which is being conducted by a team led by Atlantic Research Corporation (ARC). The team includes ISTI, Experimental Design Bureau Fakel (Fakel), and Space Systems/Loral (S/SL). The Research Institute of Applied Mechanics and Electrodynamics (RIAME) also provided support for this project. The SPT-140 is being designed, developed, manufactured, and tested by Fakel in Kaliningrad, Russia, where extensive performance testing and advanced development have been performed. In addition to the testing in Russia, a suite of experiments on the development model and the qualification model thrusters, sponsored by the US government, has occurred during 1999 and 2000 and is scheduled to continue through 2000. These experiments include thruster performance, plume characterization electromagnetic compatibility, and life characterization. This paper presents the status of government testing of the SPT-140 in the USA.
DTIC
Electric Propulsion; Hall Thrusters

20030068416 NASA Marshall Space Flight Center, Huntsville, AL, USA
Hybrid Propulsion Demonstration Program 250K Hybrid Motor
Story, George; Zoladz, Tom; Arves, Joe; Kearney, Darren; Abel, Terry; Park, O.; July 23, 2003; 15 pp.; In English; 39th AIAA/ISME/ASEE Joint Propulsion Conference and Exhibit, 20-23 July 2003, Huntsville, Al, USA; Original contains black and white illustrations
Report No.(s): AIAA Paper 2003-5198; Copyright; Avail: CASI; A03, Hardcopy

The Hybrid Propulsion Demonstration Program (HPDP) program was formed to mature hybrid propulsion technology to a readiness level sufficient to enable commercialization for various space launch applications. The goal of the HPDP was to develop and test a 250,000 pound vacuum thrust hybrid booster in order to demonstrate hybrid propulsion technology and enable manufacturing of large hybrid boosters for current and future space launch vehicles. The HPDP has successfully conducted four tests of the 250,000 pound thrust hybrid rocket motor at NASA's Stennis Space Center. This paper documents the test series.
Author
Hybrid Propulsion; Manufacturing; Technology Assessment; Rocket Engine Design; Motors; Thrust Augmentation

20030068419 NASA Marshall Space Flight Center, Huntsville, AL, USA
Exploring the Solar System
Johnson, Les; January 2003; 56 pp.; In English; National Space Society Meeting, June 5, 2003, Huntsville, Al, USA; No Copyright; Avail: CASI; A04, Hardcopy

This viewgraph presentation profiles several emerging propulsion technologies with promise for missions to explore the solar system. These technologies may reduce cost, mass, and/or travel times, and include: aerocapture, ion propulsion, solar

electric and solar thermal propulsion, solar sails, momentum exchange tethers, and plasma sails. These technologies are rated in terms of priority and profiled, along with possible missions utilizing these technologies.
CASI
Research And Development; Spacecraft Propulsion; Space Exploration; Interplanetary Spacecraft

20030068437 Science Applications International Corp., USA
Results of Evaluation of Solar Thermal Propulsion
Woodcock, Gordon; Byers, Dave; [2003]; 8 pp.; In English; 39th Joint Propulsion Conference and Exhibit, 20-23 Jul. 2003, Huntsville, AL, USA
Contract(s)/Grant(s): NASA Order H-35186D; No Copyright; Avail: CASI; A02, Hardcopy

The solar thermal propulsion evaluation reported here relied on prior research for all information on solar thermal propulsion technology and performance. Sources included personal contacts with experts in the field in addition to published reports and papers. Mission performance models were created based on this information in order to estimate performance and mass characteristics of solar thermal propulsion systems. Mission analysis was performed for a set of reference missions to assess the capabilities and benefits of solar thermal propulsion in comparison with alternative in-space propulsion systems such as chemical and electric propulsion. Mission analysis included estimation of delta V requirements as well as payload capabilities for a range of missions. Launch requirements and costs, and integration into launch vehicles, were also considered. The mission set included representative robotic scientific missions, and potential future NASA human missions beyond low Earth orbit. Commercial communications satellite delivery missions were also included, because if STP technology were selected for that application, frequent use is implied and this would help amortize costs for technology advancement and systems development. A C3 Topper mission was defined, calling for a relatively small STP. The application is to augment the launch energy (C3) available from launch vehicles with their built-in upper stages. Payload masses were obtained from references where available. The communications satellite masses represent the range of payload capabilities for the Delta IV Medium and/or Atlas launch vehicle family. Results indicated that STP could improve payload capability over current systems, but that this advantage cannot be realized except in a few cases because of payload fairing volume limitations on current launch vehicles. It was also found that acquiring a more capable (existing) launch vehicle, rather than adding an STP stage, is the most economical in most cases.
Author
Solar Thermal Propulsion; Technology Utilization; Propulsion System Performance; NASA Space Programs

20030068797 NASA Glenn Research Center, Cleveland, OH, USA
Magnetic Bearing Amplifier Output Power Filters for Flywheel Systems
Lebron-Velilla, Ramon C.; Jansen, Ralph H.; Palazzolo, Alan; Thomas, Erwin; Kascak, Peter E.; Birchenough, Arthur G.; Dever, Timothy P.; August 2003; 13 pp.; In English; First International Energy Conversion Engineering Conference, 17-21 Aug. 2003, Portsmouth, VA, USA
Contract(s)/Grant(s): WBS 22-755-60-15
Report No.(s): NASA/TM-2003-212510; E-14070; NAS 1.15:212510; No Copyright; Avail: CASI; A03, Hardcopy

Five power filters and two types of power amplifiers were tested for use with active magnetic bearings for flywheel applications. Filter topologies included low pass filters and low pass filters combined with trap filters at the PWM switching frequency. Two state and three state PWM amplifiers were compared. Each system was evaluated based on current magnitude at the switching frequency, voltage magnitude at 500 kHz, and power consumption. The base line system was a two state amplifier without a power filter. The recommended system is a three state power amplifier with a 50 kHz low pass filter and a 27 kHz trap filter. This system uses 5.57 W. It reduces the switching current by an order of magnitude and the 500 kHz voltage by two orders of magnitude. The relative power consumption varied depending on the test condition between 60 to 130 percent of the baseline.
Author
Flywheels; Low Pass Filters; Magnetic Bearings; Power Amplifiers; Topology; Spacecraft Propulsion

20030068905 CFD Research Corp., Huntsville, AL, USA
Analysis of Combustion Systems
Bain, Daniel B.; Smith, Clifford E.; Holderman, James D., Technical Monitor; June 2003; 255 pp.; In English
Contract(s)/Grant(s): NAS3-25967; WBS-22-714-01-38
Report No.(s): NASA/CR-2003-212317; E-13905; NAS 1.26:212317; No Copyright; Avail: CASI; A12, Hardcopy

As part of the NASA High-Speed Research Program, low emission combustors are being studied and demonstrated. One combustor concept that is currently being studied and evaluated is the Rich burn-Quick mix-Lean burn (RQL) combustor. The quick-mix zone of the RQL combustor is extremely important in reducing NO(x) emissions; rapid mixing of the bypass airflow with rich-born effluent is essential. The basic challenge can be described as rapid jet-in-crossflow mixing. Although jet-in-crossflow mixing is not new, this RQL application is unique in that the jet-to-mainstream mass-flow ratios are higher than studied previously (approx. 3 in RQL applications versus approx. 0.5 in dilution zone studies), plus the emphasis is on reducing NO(x) emissions (i.e. good mixing might not necessarily produce low emissions). This five-years project focused on identifying quick-mix method that would reduce NO(x) emissions in RQL combustor. The work included study of mixing concepts, and the development of design methodology. Three dimension CFD analysis was the primary tool used in assessing concept and developing design methodology for low emission. Isothermal and reacting CFD calculations were performed on cylindrical, rectangular, and annular generic geometries. Systematic parameters studies were performed to isolate key design parameters and their influence on mixing and emissions.
Derived from text
Combustion Chambers; Air Flow; Cylindrical Bodies; Design Analysis

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 25 through 29*. For astrochemistry see category *90 Astrophysics*.

20030067695 Army Soldier and Biological Chemical Command, Natick, MA, USA
Computational Studies on Acetylcholinesterase: Results from a FY 2002 DoD Challenge Project
Wright, J. B.; Hurley, Margaret; Lushington, Gerald; White, William R.; May 2003; 27 pp.; In English; Original contains color illustrations
Report No.(s): AD-A414647; NATICK/TR-03/024; No Copyright; Avail: CASI; A03, Hardcopy

This report documents the initial phases (model development) of a DoD challenge project investigating the interactions of organophosphorus compounds with acetylcholinesterase. This project entails characterization of the structural features, which lie al the heart of the interaction between novel organophosphorus compounds (or other more reversible inhibitors) and the enzyme acetylcholinesterase. Large biological systems present inherent difficulties to the modeling community. We are using quantum chemical and mixed quantum/ classical techniques, QM/MM, to examine structural effects of reactions involving novel organophosphorus compound in the active site of the enzyme, as well as the role of surrounding residues. This investigation will provide highly accurate and reliable characterizations of the biochemical processes responsible for both activity and inhibition of novel organophosphorus compounds. It is expected that the results should prove relevant to toxicological endeavors within the medical and non-medical community alike.
DTIC
Quantum Chemistry; Acetyl Compounds; Biochemistry; Cholinesterase

20030067818 Materials Research Society, Warrendale, PA
Symposium I: Nanomaterials for Structural Applications
Berndt, Christopher C.; Fischer, Traugott E.; Ovid'ko, Ilya; Skandad, Ganesh; Dec. 2002; 33 pp.; In English
Contract(s)/Grant(s): N00014-03-1-0054
Report No.(s): AD-A414790; No Copyright; Avail: CASI; A03, Hardcopy

Symposium I on Nanomaterials for Structural Applications provided an overview of current multidisciplinary research in this rapidly growing field with the primary focus of reinforcing the relationship between basic science and engineering at the nanoscale level. Thematic sessions covered nanostructured bulk materials, films, coatings, and nanocomposites. These new materials are now being introduced in structural applications, such as wear resistance and plastic-forming, and load-bearing uses. Nanophase or nanocrystalline materials are also being used in electronics, refractory, biological, and catalytic applications. Progress in a wide range of structural applications for nanomaterials crucially depends on the development of new fabrication and processing technologies, along with a fundamental understanding of the relationship between the structure and properties. Among the most important issues discussed are experimental data, and theoretical and computer models concerning deformation mechanisms in nanostructured materials, which, in general, are different from those in conventional coarse-grained materials. The competition between conventional and unusual deformation modes is believed to cause the

unique mechanical properties of nanomaterials, serving as a basis for their structural applications. Fabrication of nanomaterials with bimodal (nano-and micrograined) composite structures, that exhibit both very high strength and reasonable ductility, represents a promising strategy in synthesis of nanomaterials with enhanced mechanical characteristics for various applications. High strain rate and low-temperature super plasticity of some nanocrystalline materials are the subjects of growing fundamental research efforts motivated by a range of new applications of these super strong and super plastic materials in net shaping technologies.
DTIC
Structural Design; Composite Structures; Nanostructures (Devices)

20030068004 NASA Glenn Research Center, Cleveland, OH, USA
Novel Route to Transition Metal Isothiocyanate Complexes Using Metal Powders and Thiourea
Harris, Jerry D.; Eckles, William E.; Hepp, Aloysius F.; Duraj, Stan A.; Hehemann, David G.; Fanwick, Phillip E.; Richardson, John; July 2003; 25 pp.; In English
Contract(s)/Grant(s): NCC3-817; NCC3-869; NAG3-2484; WU 755-A4-01
Report No.(s): NASA/TP-2003-211890; E-13573; NAS 1.60:211890; No Copyright; Avail: CASI; A03, Hardcopy

A new synthetic route to isothiocyanate-containing materials is presented. Eight isothiocyanate- 4-methylpyridine (y-picoline) compounds were prepared by refluxing metal powders (Mn, Fe, Co, Ni, and Cu) with thiourea in y-picoline. With the exception of compound 5,prepared with Co, the isothiocyanate ligand was generated in situ by the isomerization of thiourea to NH4+SCN- at reflux temperatures. The complexes were characterized by x-ray crystallography. Compounds 1,2, and 8 are the first isothiocyanate- 4-methylpyridine anionic compounds ever prepared and structurally characterized. Compounds 1 and 2 are isostructural with four equatorially bound isothiocyanate ligands and two axially bound y-picoline molecules. Compound 8 is a five-coordinate copper(II) molecule with a distorted square-pyramidal geometry. Coordinated picoline and two isothiocyanates form the basal plane and the remaining isothiocyanate is bound at the apex. Structural data are presented for all compounds.
Author
Complex Compounds; Thioureas; Cyanates; Pyridines

20030068064 Yokohama National Univ., Japan
Implications Based on the Hydrolytic Stabilities of Hydrogen Cyanide and Formamide
Miyakawa, Shin; Cleaves, H. James; Miller, Stanley L.; Origins of Life and Evolution of the Biosphere; [2003]; Volume 32, pp. 195-208; In English; Original contains black and white illustrations
Contract(s)/Grant(s): NAG5-4546; Copyright; Avail: Other Sources

It has been suggested that hydrogen cyanide (HCN) would not have been present in sufficient concentration to polymerize in the primitive ocean to produce nucleic acid bases and amino acids. We have measured the hydrolysis rates of HCN and formamide over the range of 30-150 C and pH 0-14, and estimated the steady state concentrations in the primitive ocean. At 100 C and pH 8, the steady state concentration of HCN and formamide were calculated to be 7 x 10(exp -13) M and 1 x 10(exp -15) M, respectively. Thus, it seems unlikely that HCN could have polymerized in a warm primitive ocean. It is suggested that eutectic freezing might have been required to have concentrated HCN sufficiantly for it to polymerize. If the HCN polymerization was important for the origin of life, some regions of the primitive earth might have been frozen.
Author
Hydrocyanic Acid; Cyanides; Hydrolysis; Nucleic Acids; Chemical Evolution; Ammonium Compounds

20030068098 Salk Inst. for Biological Studies, San Diego, CA, USA
The Specificity of Peptide Chain Extension by N-Carboxyanhydrides
Wen, Ke; Orgel, Leslie E.; Origins of Life and Evolution of the Biosphere; [2001]; Volume 31, pp. 241-248; In English
Contract(s)/Grant(s): NAG5-4546; NAGW-1660; NAGW-2881; Copyright; Avail: Other Sources

We have used amino acids activated by carbonyldiimidazole to study the enantiospecificity of peptide elongation in aqueous solution. Peptide primers Glu(sub 10) and Ala3Glulo were elongated with the enantiomers of arginine, glutamic acid, asparagine, phenylalanine, serine and valine. The homochiral addition was always the more efficient reaction; the enantiospecificity was large in some cases but very small in others. In every case Ala(sub 3)Glu(sub l0) was elongated more efficiently than Glu(sub 10).
Author
Peptides; Phenylalanine; Amino Acids

20030068237 Brookhaven National Lab., Upton, NY

Hydrogen Outgassing and Surface Properties of TiN-Coated Stainless Steel Chambers

He, P.; Hseuh, H. C.; Mapes, M.; Todd, R.; Weiss, D.; 2002; 12 pp.; In English

Report No.(s): DE2003-807520; BNL-69630; No Copyright; Avail: Department of Energy Information Bridge

The stainless steel vacuum chambers of the 248m accumulator ring of Spallation Neutron Source (SNS) are coated with (approx) 100 nm of titanium nitride (TiN) to reduce the secondary electron yield. The coating is produced by DC magnetron sputtering using a long cathode imbedded with permanent magnets. The outgassing rates of several SNS half-cell chambers were measured with and without TiN coating, and before and after in-situ bake. One potential benefit of a TiN coating is to serve as hydrogen permeation barrier that reduces the ultimate outgassing rate. By varying the coating parameters, films of different surface roughness were produced and analyzed by Auger electron spectroscopy, scanning electron microscopy and atomic force microscopy to illustrate the dependence of the outgassing on the film structure.

NTIS

Hydrogen; Titanium Nitrides; Stainless Steels; Vacuum Systems

20030068548 Academy of Sciences (USSR), Moscow, USSR

Charge-Based Deep Level Transient Spectroscopy of Defects in Electron-Irradiated and Annealed CVD Diamonds

Polyakov, V. I.; Rukovishnikov, A. I.; Rossukanyi, N. M.; Ralchenko, V. G.; Vlasov, I. I.; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 285-290; In English; See also 20030068525; Original contains black and white illustrations

Contract(s)/Grant(s): INTAS-01-2173; RFBR-01-02-16046; No Copyright; Avail: CASI; A02, Hardcopy

Electrically active defects in undoped and moderately boron-doped microwave plasma CVD diamond films subjected to electron-irradiation and/or vacuum annealing to high, up to 1625 C, temperatures were studied with Charge-based Deep Level Transient Spectroscopy. Concentration, activation energy EA, and capture cross-section of native and boron-related defects are determined. The undoped samples before the treatments displayed the acceptor defects with a continuous energy spectrum, while the B-doped samples showed two discrete levels with EA of 0.37 and 0.25 eV. The electron irradiation (2 MeV, dose 5 1018 cm-2) changes the parameters of boron-induced levels, reduces the concentration of the defects with the continuous energy spectrum, and strongly, by four orders of magnitude, reduces electrical conductivity. After annealing only one B-related level with EA = 0.37 eV (boron in substitutional position) remains, but simultaneously an increase in abundance of acceptor defects with low activation energy was observed.

Author

Diamond Films; Doped Crystals; Vapor Deposition; Boron

20030068555 Kurchatov (I. V.) Inst. of Atomic Energy, Moscow, USSR

Chemical Reactions of C-Atoms with Nanodiamond and Diamond Surfaces

Dementjev, A. P.; Maslakov, K. I.; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 279-283; In English; See also 20030068525; No Copyright; Avail: CASI; A01, Hardcopy

The deposition of carbon atoms on surfaces of: a) silicon substrate; b) ultra dispersion diamond (UDD) and natural diamond (110) after H-treatment (ND-H-t) has been studied in-situ by N(E) CKVV AES with x-ray excitation combined with C1s and valence band XPS techniques. The chemical state (Cd) of carbon atoms on the surfaces of ND-H-t is identical to that in UDD. According to the CKVV Auger spectra the Cd state is conditioned by -band different from that of graphite. The carbon atoms were prepared by decomposition of CH4 on W hot-filament at 2300 K. In case a) the carbon atoms formed a graphite-like structure. In case b) the CKVV Auger spectra did not show any modification of initial chemical state on UDD or ND-H-t surfaces up to about 4 monolayers. The results point to incorporation of carbon atoms into diamond structure.

Author

Diamond Films; Crystal Surfaces; Nanostructure Growth; Carbon; Vapor Deposition

20030068642 Kurchatov (I. V.) Inst. of Atomic Energy, Moscow, USSR

Identification of the Chemical State of Carbon Atoms on Nanodiamond Powder Surfaces

Dementjev, A. P.; Maslakov, K. I.; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 266-270; In English; See also 20030068525; No Copyright; Avail: CASI; A01, Hardcopy

The chemical state of carbon atoms on surface of nanodiamond particles is not known. In order to identify the chemical

state the N(E) CKVV Auger spectroscopy with X-ray excitation of Auger emission have been used. According to the CKVV data on the surfaces of nanodiamond particles the carbon atoms have the same electron configuration as in graphite: s 1 p 2 1, but opposite to graphite the . transitions do not take place. The phenomenon is evidence of absence of overlapping -levels. The same chemical state takes place on surface of natural diamond (110) after H-treatment. The chemical state is inactive to environment.
Author
Diamond Films; Nanostructure (Characteristics); Surface Layers; Crystal Surfaces; Carbon

20030068651 Technische Univ., Berlin, Germany
Wear Behavior of Thin CVD Diamond Films During the Interrupted Cut
Uhlmann, Eckart; Kott, Rouven; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 228-233; In English; See also 20030068525; Original contains black and white illustrations; No Copyright; Avail: CASI; A02, Hardcopy

CVD diamond films are often used as wear protection for cutting tools. During the machining of non-ferrous metal alloys nano- and microcrystalline CVD diamond films reduce abrasive wear due to their inherent hardness. In many applications this coating technology has the potential to replace conventional polycrystalline diamond (PCD) with binder as cutting material. As opposed to PCD, CVD diamond not only offers outstanding properties but also has a high geometrical flexibility regarding the tools to be coated when deposited as a thin film. However, in the past adhesion problems of CVD diamond films have limited their application range. This becomes especially evident during machining in the interrupted cut. Recent developments in the tool coating industry such as customized pre-treatment methods of the substrate have led to CVD diamond films with improved film adhesion. Hence this paper discusses the wear behavior of newly developed CVD diamond films during face milling of the aluminum cast alloy G-AlSi7Cu4Mg. In addition to the cutting experiments to separately investigate the adhesive and abrasive wear behavior of the films model tests were performed.
Author
Diamond Films; Polycrystals; Vapor Deposition; Wear

24
COMPOSITE MATERIALS

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

20030067724 Army Research Office, Research Triangle Park, NC
Photonic Crystal HIDE Materials Engineering
Kimerling, L. C.; Feb. 2001; 30 pp.; In English
Contract(s)/Grant(s): DAAG55-97-1-0366
Report No.(s): AD-A414716; ARO-37663.9-PH; No Copyright; Avail: CASI; A03, Hardcopy

Milestone results have been achieved in the design, processing and testing of dielectric and metallodielectric composite materials for the control of IR emissivity. Our theoretical analyses have shown that an omnidirectional reflectivity band can be produced with high dielectric contrast, multilayer structures. The theory was applied to design and fabricate a structure comprised of alternating Te and polymer layers that were produced by low cost evaporation and spin coating processes, respectively. These materials exhibit near perfect, omnidirectional reflectivity in the 8-12 mm range, and they can be easily fabricated for response within the 2-25 mm range. In the next term, we will develop a design foundation for materials selection and microstructural processing. We have developed a novel, low-cost process for the periodic placement of micron-dimensioned spheres and clusters of metal particles in two dimensional arrays. This process is the first example of stamping and filling a template with high precision at dimensions relevant to metallodielectric HIDE materials. A novel waveguide which utilizes the omnidirectional mirror to localize light in air was developed. This in turn led to the discovery of an optical coaxial waveguide which supports a TEM like mode in a a non-metallic structure.
DTIC
Composite Materials; Single Crystals; Dielectrics

20030067978 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Outgassing Data for Selecting Spacecraft Materials
Campbell, William A., Jr.; Marriott, Richard S.; August 1987; 320 pp.; In English
Report No.(s): NASA-RP-1124-Rev; Rept-87B0347-Rev; NAS 1.61:1124-Rev; No Copyright; Avail: CASI; A14, Hardcopy

Outgassing data, derived from tests at 398 K (125 C) for 24 hours in vacuum as per ASTM E 595-77, have been compiled for numerous materials for spacecraft use. The data presented are the total mass loss (TML) and the collected volatile condensable materials (CVCM). The various materials are compiled by likely usage and alphabetically.
Author
Outgassing; Spacecraft Construction Materials; Weight (Mass); Data Processing

20030068093 NASA Glenn Research Center, Cleveland, OH, USA
LS-DYNA Implementation of Polymer Matrix Composite Model Under High Strain Rate Impact
Zheng, Xia-Hua; Goldberg, Robert K.; Binienda, Wieslaw K.; Roberts, Gary D.; September 2003; 20 pp.; In English; 35th International Technical Conference, 28 Sep. - 2 Oct. 2003, Dayton, OH, USA
Contract(s)/Grant(s): WBS 22-708-24-05
Report No.(s): NASA/TM-2003-212583; E-14123; NAS 1.15:212583; No Copyright; Avail: CASI; A03, Hardcopy

A recently developed constitutive model is implemented into LS-DYNA as a user defined material model (UMAT) to characterize the nonlinear strain rate dependent behavior of polymers. By utilizing this model within a micromechanics technique based on a laminate analogy, an algorithm to analyze the strain rate dependent, nonlinear deformation of a fiber reinforced polymer matrix composite is then developed as a UMAT to simulate the response of these composites under high strain rate impact. The models are designed for shell elements in order to ensure computational efficiency. Experimental and numerical stress-strain curves are compared for two representative polymers and a representative polymer matrix composite, with the analytical model predicting the experimental response reasonably well.
Author
Mathematical Models; Micromechanics; Polymer Matrix Composites; Strain Rate; Mechanical Properties; Impact Tests; Finite Element Method

20030068253 NASA Glenn Research Center, Cleveland, OH, USA
Ceramic Matrix Composites (CMC) Life Prediction Development: 2003
Levine, Stanley; Calomino, Anthony M.; Verrilli, Michael J.; Thomas, David J.; Halbig, Michael C.; Opila, Elizabeth J.; Ellis, John R.; August 2003; 21 pp.; In English; 27th Annual Conference on Composites, Materials and Structures, 27-31 Jan. 2003, Cape Canaveral, FL, USA; Original contains color and black and white illustrations
Contract(s)/Grant(s): WBS 22-713-82-32
Report No.(s): NASA/TM-2003-212493; E-14042; NAS 1.15:212493; Copyright; Avail: CASI; A03, Hardcopy

Accurate life prediction is critical to successful use of ceramic matrix composites (CMCs). The tools to accomplish this are immature and not oriented toward the behavior of carbon fiber reinforced silicon carbide (C/SiC), the primary system of interest for many reusable and single mission launch vehicle propulsion and airframe applications. This paper describes an approach and progress made to satisfy the need to develop an integrated life prediction system that addresses mechanical durability and environmental degradation of C/SiC.
Author
Ceramic Matrix Composites; Silicon Carbides; Carbon Fibers; Life (Durability)

20030068318 NASA Glenn Research Center, Cleveland, OH, USA
Probabilistic Evaluation of Advanced Ceramic Matrix Composite Structures
Abumeri, Galib H.; Chamis, Christos C.; July 2003; 52 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): WBS-22-708-48-11
Report No.(s): NASA/TM-2003-212515; E-14075; NAS 1.15:212515; No Copyright; Avail: CASI; A04, Hardcopy

The objective of this report is to summarize the deterministic and probabilistic structural evaluation results of two structures made with advanced ceramic composites (CMC): internally pressurized tube and uniformly loaded flange. The deterministic structural evaluation includes stress, displacement, and buckling analyses. It is carried out using the finite element code MHOST, developed for the 3-D inelastic analysis of structures that are made with advanced materials. The probabilistic evaluation is performed using the integrated probabilistic assessment of composite structures computer code IPACS. The affects of uncertainties in primitive variables related to the material, fabrication process, and loadings on the material property and structural response behavior are quantified. The primitive variables considered are: thermo-mechanical properties of fiber and matrix, fiber and void volume ratios, use temperature, and pressure. The probabilistic structural analysis and probabilistic strength results are used by IPACS to perform reliability and risk evaluation of the two structures. The results will show that the sensitivity information obtained for the two composite structures from the computational simulation can be

used to alter the design process to meet desired service requirements. In addition to detailed probabilistic analysis of the two structures, the following were performed specifically on the CMC tube: (1) predicted the failure load and the buckling load, (2) performed coupled non-deterministic multi-disciplinary structural analysis, and (3) demonstrated that probabilistic sensitivities can be used to select a reduced set of design variables for optimization.
Author
Ceramic Matrix Composites; Stress Analysis; Structural Analysis; Structural Failure

20030068563 National Inst. of Advanced Industrial Science and Technology, Tohoku, Japan
Development of Hard Carbon Films and Characterization of Their Tribological Properties for the Frontier Carbon Technology Project
Tanaka, Akihiro; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 413-418; In English; See also 20030068525; Original contains color illustrations; No Copyright; Avail: CASI; A02, Hardcopy

In Japan, a national project called the 'Frontier Carbon Technology (FCT)' project has been in existence from 1998 with a five-year plan for development. This project included Research and Development of processing technologies with materials that had highly desirable mechanical properties such as low friction, high wear resistance, and high adhesion. Diamond-Like Carbon (DLC) films with excellent friction and wear properties were prepared using thermal electron excited plasma Chemical Vapor Deposition (CVD) system. This system was characterized by a pulse-bias technique. The DLC film deposited under the appropriate conditions exhibited low friction coefficients (0.03 to 0.07), and a small specific wear rate of 3x10(exp -9)-cu mm/Nm; these values were superior to the desired targets of the FCT project. Adhesion of DLC film to the substrate was improved using a process consisting of Electron Cyclotron Resonance (ECR) plasma-enhanced CVD combined with high-energy ion implantation. The DLC film deposited by this system exhibited stability (i.e., without peeling) under severe sliding conditions that included a 100-N load (maximum contact pressure of 2.6-GPa). DLC films were synthesized on complex-shape substrates by a plasma-based ion implantation (PBII) system developed for the FCT project. The thickness uniformity of the DLC film deposited on a substrate which simulated a complex-shape was within a distribution of +/-10 %. A journal bearing unit was coated by a CVD diamond-film. The bearing unit, which was accurately finished by high speed grinding, demonstrated very low friction.
Author
Carbon; Diamond Films; Friction; Tribology; Wear

20030068564 Korea Inst. of Tech., Seoul, Korea, Republic of
Frictional Behavior of Nano-Undulated Surface of Diamond-Like Carbon Films
Park, S. J.; Lee, C. S.; Kim, T. Y.; Lee, K. -R.; Ko, D. -H.; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 419-422; In English; See also 20030068525; Original contains color and black and white illustrations; No Copyright; Avail: CASI; A01, Hardcopy

Frictional behavior of nano-undulated diamond-like carbon (DLC) films deposited by plasma assisted chemical vapor deposition (PACVD) process was investigated. In order to prepare the nano-undulated DLC film, a Si wafer with nano-sized Ni dots was prepared by rapid thermal annealing of Ni thin films. Since the structure of DLC film deposited by PACVD was independent of the substrate materials and that the size of Ni nano dots could be controlled in a systematic way by changing the thickness of the Ni film, we could investigated the effect of nanoscale surface roughness on the tribological behavior of DLC films. The friction coefficient between steel ball and undulated DLC films of the roughness varying from 0.6 to 13.7 nm was measured by using a ball-on-disk type wear rig in ambient environment. The friction coefficients were in the range from 0.15 to 0.2, independent of the surface roughness. Wear of the steel ball was much enhanced with higher content of Fe in the debris as the roughness increased. However, the size of the debris decreased with increasing roughness. Raman spectrum analysis revealed that the chemical bond structure of the debris is significantly dependent on the surface roughness. The friction behavior was discussed in terms of the chemical compositions and the agglomeration behavior of debris.
Author
Friction; Diamond Films; Carbon; Vapor Deposition; Thin Films; Annealing

20030068576 Agency of Industrial Science and Technology, Tsukuba, Japan
Tribological Properties of a-C:H Thin Films Formed by the Simultaneous Application of Pulse and DC Bias
Watanabe, Toshiya; Tsuda, Osamu; Suzuki, Masahiro; Yamamoto, Kazuhiro; Koga, Yoshinori; Tanaka, Akihiro; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 429; In English; See also 20030068525; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

Ion-beam-assisted deposition is an efficient technique to synthesize metastable hard materials. However, it is difficult to apply this technique to surface modification of three-dimensional or complex shaped objects because of the line-of-sight process of ion beams. A new surface modification technique called Plasma Based Ion Implantation (PBII),. is currently being studied. This is a surface modification technique that applies negative high voltage pulses to the object immersed in a plasma, and ions in a plasma are able to irradiate in any direction to the object. In this study, carbon films were formed by the application of pulse and DC bias. The relationship between the deposition conditions, such as voltage and duty ratio, and the tribological properties of carbon films were investigated. DLC films with a low friction coefficient (0.02) and a low wear rate (6x10(exp -8)cu mm/Nm) under high conducted load (20 N) could be formed by the simultaneous application of the pulse (-2kV) of duty ratio (1%) and the DC bias (-200V) for the surface of convex and concave faces with high uniformity. The uniformity of the film thickness, structure and the mechanical property was much improved over the conventional deposition technique that uses an ion beam.
Author
Thin Films; Ion Beams; Plasmas (Physics); Tribology; Ion Implantation

20030068595 National Inst. for Materials Science, Tsukuba, Japan
Carbon Nanotube Nucleation from Graphitic Nanofragments
Louchev, Oleg A.; Hester, James R.; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 52; In English; See also 20030068525; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

A detailed analysis of nanotube nucleation from graphitic nanofragments by thermal vibration via the interaction with amorphous carbon, fullerene-like and carbonized metal catalyst nanoparticles is given predicting a variety of nanotube chiralities observed experimentally. The issue of kinetic selection between (i) carbon nanosheet wrapping around the metal nanoparticle, (ii) NT growth from the nanoparticle surface by the root mechanism and (iii) metal nanoparticle surface being covered by an amorphous carbon layer is considered. The temperature fall rate and the heat dissipation by the inert gas are shown to play a crucial role in providing conditions for the root mechanism of NT nucleation. At low inert gas pressure the heat dissipation is very slow and the time required for particle cooling and C segregation is comparable with the characteristic time of C impingement into the surface from vapor. Under these conditions nanoparticles will be covered by C impinging from the vapor, and the root mechanism of NT nucleation is inhibited. In this case the nanoparticle provides a template for carbon condensation which can lead to the formation of a graphitic layer and nanoring nuclei wrapped around the nanoparticle. However, at inert gas pressures >0.1 bar the characteristic time for metal-carbon nanoparticle cooling becomes much lower than the characteristic impingement time of C from vapor providing conditions for NT nuclei formation by the kinetic pathway of C segregation from metal particle and root mechanism.
Author
Carbon Nanotubes; Nucleation; Graphite; Fragments; Nanotechnology

20030068598 Max-Planck-Inst. fuer Chemie, Mainz, Germany
On Bulk Modulus of Superhard 3D Polymers of Carbon Nanocluster
Popov, M.; Koga, Y.; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 64; In English; See also 20030068525; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

New superhard phase of single wall carbon nanotube (SP-SWNT) has been compared experimentally with 3D polymeric phases of analogous carbon cluster - fullerene C60 (both SWNT and C60 composed from curved graphene sheets). Mechanical properties of material composed from the polymerized clusters are determined by properties of the cluster. The 3D carbon nanocluster polymers were studied both in situ under pressure in a shear diamond anvil cell and after pressure release. Information about bulk modulus was derived from the pressure dependence for the phonon mode in high-energy range of the Raman spectra (i.e. the band 1594 cm-1 for SP-SWNT and 1570 cm-1 for 3D polymer of C60). This mode is similar for both materials: it is the bond-stretching mode of pair of carbon sp2 atoms, it is building bond for the clusters and in general it does not require the presence of graphitic structure and lies in the range 1500-1630 cm-1. In present study the Gruneisen parameter for 3D fullerite polymer was estimated experimentally using available experimental and theoretical data for bulk modulus of ultrahard fullerite (540 to 800 GPa depending on structure and synthesis conditions). The reasonable value for the fullerite Gruneisen parameter is the same as for the graphene sheet (1.1). The same value was used for the present estimation of bulk modulus of SP-SWNT (465 GPa). The value is close to diamond and consistent with theoretical calculations 420 GPa (L.A. Chernozatonskii et all. JETP Letters, 74, 467 (2001)). In addition to high bulk modulus SP-SWNT reveals superhard properties: its hardness (62 to 150 GPa) belongs to the range between cubic BN and diamond. Self-consistency of the

experimental data and their correspondence with theoretical calculations gives base for an estimation and prediction of mechanical properties of new carbon nanocluster-based polymeric materials.
Author
Bulk Modulus; Carbon Nanotubes; Polymerization; Fullerenes; Three Dimensional Models; Hardness; Atomic Clusters

20030068600 Tokyo Inst. of Tech., Tokyo, Japan
Frictional Properties of Carbon Nanotube Reinforced Polymer Matrix Composites
Enomoto, Kazuki; Yasuhara, Toshiyuki; Kitakata, Shintaro; Murakami, Hiroya; Ohtake, Naoto; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 70-75; In English; See also 20030068525; Original contains black and white illustrations; No Copyright; Avail: CASI; A02, Hardcopy

Carbon nanotubes (CNTs) are expected to be a new functional material. We fabricated polystyrene (PS) matrix composites filled with multi-walled carbon nanotubes (MWCNTs) and vapor grown carbon fibers (VGCFs). The concentration of the fillers in the composites was varied from 0 to 50 wt%. Specimens were fabricated by injection molding and friction coefficient and wear resistance of the surface of the molded specimens were measured using a ball-on-disk friction tester. In the case of VGCF/PS composites, the friction coefficient decreased with increasing the filler concentration, although the surface roughness increased with the filler concentration. Finally, the friction coefficient decreased from mu=0.45 to mu=0.2 when VGCF concentration was 50wt%. In the case of MWCNT/PS composites, the friction coefficient was almost same as that of bulk polystyrene when the MWCNT concentration was 30wt%. The change in the friction coefficient of CNT/PS composites was discussed in terms of the surface roughness, CNT contact area and Young s modulus. The specific wear rate of CNT/PS composites was also measured. The wear rate of MWCNT was 2.0 x 10(exp -7) cubic millimeters/N, that is eight-fold smaller than VGCF/PS composites.
Author
Carbon Nanotubes; Fabrication; Friction; Polymer Matrix Composites; Reinforcing Materials; Polystyrene

20030068657 Oiles Corp., Fujisawa, Japan, Oiles Corp., Fujisawa, Japan
Tribological Properties of Ti-DLC Films on Various Polymers
Miyake, S.; Watanabe, S.; Sato, M.; Hashizume, T.; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 445-446; In English; See also 20030068525; No Copyright; Avail: CASI; A01, Hardcopy

Our study is to search for tribological properties of diamond-like carbon (DLC) film known as anti-wear hard thin film on various polymers. This report discusses the deposition of DLC films on various polymer substrates in vacuum by magnetron radio frequency (RF) sputtering method with using argon plasma and graphite, titanium target. The properties of friction and wear were measured using a ball-on-disk wear -testing machine. The properties of friction and wear were remarkably improved by DLC coating. Furthermore, the composition of DLC film was been analyzed by using auger electron spectroscopy (AES). The wear rate of titanium- containing DLC film was lower than that of no-metal-containing DLC film.
Author
Thin Films; Diamond Films; Titanium; Graphite; Polymer Matrix Composites

20030068661 Air Force Research Lab., Wright-Patterson AFB, OH, USA
Solid Lubricant Properties of Carbon Nanomaterials and Their Polymeric Composite Coatings
Chen, M. Y.; Korfhagen, S. T.; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 444; In English; See also 20030068525; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

Co-continuous alumina/aluminum based composites with excellent physical and mechanical properties offer great potentials for lightweight, wear resistant, and high temperature applications. The development of suitable coating materials will provide low coefficient of friction to extend life under different environments for aerospace applications. In this study, carbon powders containing diamond clusters or fullerene were burnished on to the surface of alumina/aluminum substrates. These powders and c-nanofiber materials were also incorporated in polymer matrices and were spin coated onto the alumina/aluminum composites. Performance of a newly developed aerospace thermoplastic material and two currently used aircraft canopy materials were chosen as the matrix materials for comparison. Tribological evaluation of alumina/aluminum composites with and without coatings was performed against 440C stainless steel balls using pin-on-disc wear tests at 0.2 m/s sliding velocity, 0.25 N, and 0.75 N normal load. The morphology and wear tracks on the composite discs and material transfer to the steel balls were examined using a scanning electron microscope. Raman analysis was performed to determine the

chemical bonding of the as-burnished materials and the changes after wear tests. The effects of reinforcement or lubricant material, polymer matrix material and test environment on the friction behavior will be presented.
Author
Lubricants; Composite Materials; Solid Lubricants; Polymeric Films; Polymer Matrix Composites

20030068699 Air Force Research Lab., Wright-Patterson AFB, OH, USA
Tribological Characteristics of Novel Superhard Carbon Compacts for Self-Lubricating Applications
Chen, M. Y.; Korfhagen, S. T.; Voronov, O. A.; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 406; In English; See also 20030068525; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

Tribological performance of a recently developed hard carbon material (Diamonite(TM)) was evaluated. The samples of new carbon ceramic were sintered from fullerene C-60 under high pressure. Pin-on-disc experiments were performed without lubrication between 440C stainless steel balls and the superhard carbon disc samples at 200-400 rpm, with loads of 0.25 N, 0.5 N and 1.00 N. The testing environments include humid air (40 % RH) and dry nitrogen atmospheres. Microstructural analysis of the as-sintered carbon ceramic, wear scar analysis on the carbon discs, and material transfer to the steel balls were examined using a scanning electron microscope. The coefficients of friction obtained were 0.15-0.17 in lab air. In dry testing condition, the material showed surprisingly low coefficients of friction (0.05-0.12). Raman analysis was used to determine the chemical bonding of the as-polished materials and the changes in sp3 to sp2 ratio of carbon bonding before and after wear tests. Comparisons of the tribological performance of new carbon ceramic with diamond ceramic will be presented. The results demonstrated the feasibility of using this fullerene-derived carbon material with a low coefficient of friction for self-lubricating antifriction applications.
Author
Tribology; Lubrication; Friction; Carbon; Diamonds; Friction Reduction

20030068923 NASA Glenn Research Center, Cleveland, OH, USA
Polyimides by Photochemical Cyclopolymerization
Meador, Michael A., Inventor; July 15, 2003; 9 pp.; In English
Patent Info.: Filed 5 Apr. 2001; US-Patent-6,593,389; US-Patent-Appl-SN-827140; NASA-Case-LEW-17133-1; No Copyright; Avail: CASI; A02, Hardcopy

The polyimides of this invention are derived from a Diels-Alder cyclopolymerization of a photochemically generated bisdiene with dienophiles, such as bismaleimides, trismaleimides and mixtures thereof with maleimide end-caps. Irradiation of one or more diketones produces two distinct hydroxy o-quinodimethane (photoenol) intermediates. These intermediates are trapped via a Diels-Alder cycloaddition with appropriate dienophiles, e.g., bismaleimide and/or trismaleimides to give the corresponding polyimides in quantitative yields. When bismaleimides, trismaleimides or mixtures thereof with maleimide end-caps are used as the dienophile, the resulting polyimides have glass transition temperatures (Tg) as high as 300 C. Polyimide films can be prepared by ultraviolet irradiation of high solids content varnishes of the monomers in a small amount of solvent, e.g., cyclohexanone, dimethyl formamide, N-methylpyrollidone and the like. These polyimides are characterized as having high glass transition temperatures, good mechanical properties and improved processing in the manufacture of adhesives, electronic materials and films.
Official Gazette of the U.S. Patent and Trademark Office
Polyimides; Photochemical Reactions; Polymerization

25
INORGANIC, ORGANIC AND PHYSICAL CHEMISTRY

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

20030067691 Materials Research Society, Warrendale, PA
International Workshop on Zinc Oxide (2nd)
Look, David C.; Jun. 9, 2003; 5 pp.; In English
Contract(s)/Grant(s): N00014-02-1-0814
Report No.(s): AD-A414637; No Copyright; Avail: CASI; A01, Hardcopy

The format of this workshop will differ from that of the typical conference or symposium by having a very narrow focus, ZnO materials and devices only. and by emphasizing discussion rather than a simple presentation of data. The purposes of the workshop will be to: (1) enhance current ZnO projects by the informal exchange of information; (2) encourage new experimental and theoretical efforts, as needed; (3) discuss the future potential of ZnO, especially now that type material has been demonstrated; and (4) provide up-to-date information for any representatives of DOD funding agencies who might be interested in promoting ZnO programs. The workshop will consist of four main sessions: growth, characterization, processing, and applications.
DTIC
Zinc Oxides; Conferences

20030067696 Air Force Research Lab., Edwards AFB, CA, USA
Structural Effects on the Physical Properties of Ionic Liquids
Drake, Greg; Wilkes., John; May 6, 2003; 23 pp.; In English; Original contains color illustrations
Report No.(s): AD-A414649; AFRL-PR-ED-VG-2003-122; No Copyright; Avail: CASI; A03, Hardcopy

Ionic liquids are a class of salts consisting of cation/anion pair that has a very low melting point. Definition of an ionic liquid is open to some debate amongst researchers in the area, but most in the are use of two. 1) An ionic compound that melts below 100 degrees C (b.p. of H2O). 2)An ionic compound that has a melting point at or below ambient temperatures. These are often called RTILs (Room Temperature Ionic Liquids).
DTIC
Cations; Physical Properties; Salts; Anions

20030067702 Johns Hopkins Univ., Laurel, MD, USA
Electronically Excited Oxygen
Silver, David M.; Mar. 2002; 5 pp.; In English
Contract(s)/Grant(s): DAAG55-98-1-0515
Report No.(s): AD-A414664; JHU/APL-2000-1; ARO-37298.1-EL; No Copyright; Avail: CASI; A01, Hardcopy

The specific aim of this research project was to explore the role of electronically excited oxygen in a variety of processes: combustion, spontaneous ignition, cool flames, and unusual structural forms of oxygen. The results show that electronically excited oxygen participates in cool flame combustion through a chain mechanism involving a manifold of electronically excited molecular species. At elevated temperatures of 600 K that are much lower than normal combustion temperatures, electronically excited oxygen reacts with hydrocarbons (for instance, through ene-reactions) at rates that are 10-20 times faster than quenching of the excited state. The significance of this result is that the oxygen excitation process can be exploited to enhance the fuel burning properties of internal combustion engines and that the spontaneous oxidation (combustion) of liquid fuels can be explained. A further result is that a valence bond analysis of assemblies of oxygen molecules provides insight into their electronic structure. The significance of this result is in explaining the nature of bonding between oxygen atoms in an extended molecular system.
DTIC
Excitation; Oxygen

20030067715
Development of SiC Power MOSFETs with Low On-Resistance for Military and Commercial Applications
Cooper, James A., Jr; Mar. 31, 2003; 251 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): N00014-01-1-0072
Report No.(s): AD-A414680; No Copyright; Avail: CASI; A12, Hardcopy

A large number of applications for power switching devices lie in the voltage range from 600-1800 V. In this regime, the specific on-resistance of SiC power MOSFETs is limited by their MOS channel resistance, due to the low inversion layer electron mobility at the SiO2/SiC MOS interface. Although significant progress has been made in increasing the electron mobility, it is still about an order-of-magnitude lower than in silicon devices. Our approach to this problem is to implement structural changes, namely short channel lengths, that will directly reduce channel resistance independent of and in addition to any improvements in channel mobility. The short-channel DMOSFETs utilize a novel self-aligned implantation process that easily and reliably produces sub-half-micron channel lengths.
DTIC
Silicon Carbides; Metal Oxide Semiconductors

20030067720 TRW Space and Electronics Group, Redondo Beach, CA

The Effects of Rocket Exhaust on Stratospheric Ozone: Chemistry and Diffusion

Lohn, Peter D.; Wong, Eric Y.; Spencer, Darryl D.; Meads, Roger; Molina, Luisa T.; Aug. 1996; 150 pp.; In English

Report No.(s): AD-A414699; No Copyright; Avail: CASI; A07, Hardcopy

This study extends the work of M. R. Denison et al. (Journal of Spacecraft and Rockets, v31 n3, p435-442, May-June 1994) who described a methodology that allowed the quantitative assessment of the impact of rocket exhaust on stratospheric ozone. The local, short time, effect and the ultimate global effect of rocket exhaust are evaluated through the use of a high-resolution ozone imager (HIROIG). Analysis of solid rocket motor (SRM) induced depletion of ozone during a TITAN III launch showed that the level of ozone column density loss was about 0.25% over an area of 20 km after 2 hours. After 9 hours, the plume size increased and the affected area increased to 70 km at approximately 0.1%. In the north pole region, the loss peaks at about 0.06% while the rest of the globe has a loss of about 0.01%. The local hole produced by a single SRM launch is approximately 2 km to 4 km in radius and persists for a few thousand seconds after which it fills in by diffusion. Plume transport takes place in the upper stratosphere on a level much larger than in the lower stratosphere as a result of strong stratospheric winds. The plume tends to remain in the neighborhood of the launch site for as long as 9-10 hours with about 70% recovery from the initial ozone depletion. In winter launches the plume tends to linger near the launch site longer than in summer launches. The long-term global impact of a single 2.4 million pound SRM in steady state is estimated to be a 0. 001% to 0.006% reduction of stratospheric ozone per year. Loss of stratospheric ozone caused by liquid rocket engine boosters that produce nitric oxide is considerably less than that caused by SRM boosters, which produce large amounts of chlorine in the boost phase. The nitric oxide catalytic cycle mechanism causes less ozone destruction than chlorine. At present, all large-thrust U.S. launch vehicles are chlorine-based SRMs. This work also provides inputs for further refining the HIROIG. (4 tables, 100 figures, 23 ref7

DTIC

Atmospheric Chemistry; Rocket Exhaust; Plumes

20030067721 NASA Marshall Space Flight Center, Huntsville, AL, USA

Purification, Crystallization, and Preliminary X-ray Analysis of Native Canavalin

Pusey, Marc; Dowell, Jennifer; Ng, Joseph; Gavira, Jose A.; [2003]; 1 pp.; In English; American Crystallographic Association, 28 Jul. 2003, Covington, KY, USA; Copyright; Avail: Other Sources; Abstract Only

The protein canavalin is a 7S vicilin, from the Jack Bean, Canavalis ensfomis. Canavalin is described as a seed storage protein, an energy source for a developing seed, as no other known activity or function has been found. The protein was first isolated and crystallized by Sumner and Howell (J. Biol. Chem. 113, 607-610, 1936). Canavalin spontaneously crystallizes after proteolytic cleavage at neutral pH, which removes residues 1-46, 224-245, and 325-330 and produces peptides of approximately 25, 13, and 12 kDa. Preliminary gel filtration experiments indicated the presence of nucleic acid with the uncleaved protein. We developed a dual column procedure, ion exchange followed by hydroxy apatite chromatography, that effectively removes the nucleic acid and yields an essentially pure uncut canavalin preparation with an OD 280/260 ratio of approximately 1.9-2.0. Standard crystallization screens using this material gave a number of positive results having a common requirement for alcohols and Mg(2+) ion, with crystals typically appearing within a day or less. Optimization experiments to date have shown that we can obtain crystals from pH 6.5 to pH 8.2, using MPD from 5 to 20% and 0.05 to 0.2M Mg(2+) (sulfate or acetate). The crystals are of space group P2(sub 1)2(sub 1)2(sub 1), unit cell dimensions, and a complete data set to 1.5 Angstroms, resolution has now been collected at a synchrotron source. Most importantly, the crystals are not twinned, a persistent problem with the most commonly obtained rhombohedral form of proteolytically cleaved canavalin.

Author

Crystallization; Proteins; Purification; X Ray Analysis; Molecular Structure

20030067738 NASA Marshall Space Flight Center, Huntsville, AL, USA

Crystal Structure of the Catalytic Domain of a Serine Threonine Protein Phosphatase

Swinglel, Mark; Honkanel, Richard; Ciszak, Ewa; [2003]; 1 pp.; In English; American Crystallographic Association (ACA), 26-31 Jul. 2003, Covington, KY, USA; Copyright; Avail: Other Sources; Abstract Only

Reversible phosphorylation of serine and threonine residues is a well-recognized mechanism in eukaryotic cells for the regulation of cell-cycle progression, cell growth and metabolism. Human serine/threonine phosphatases can be placed into two major families, PPP and PPM. To date the structure on one PPP family member (PPl) has been determined. Here we present the structure of a 323-residue catalytic domain of a second phosphatase belonging to the PPP family of enzyme. catalytic domain of the enzyme has been determined to 1.60Angstrom resolution and refined to R=17.5 and Rfree = 20.8%. The catalytic domain possesses a unique fold consisting of a largely monolithic structure, divisible into closely-associated helical

and sheet regions. The catalytic site contains two manganese ions that are involved in substrate binding and catalysis. The enzyme crystallizes as a dimer that completely buries catalytic surfaces of both monomers, Also, the structure shows evidence of some flexibility around the active site cleft that may be related to substrate specificity of this enzyme.
Author
Crystal Structure; Proteins; Phosphorylation; Catalytic Activity; Cells (Biology)

20030067796 General Accounting Office, Washington, DC
Defense Management: Opportunities to Reduce Corrosion Costs and Increase Readiness
Jul. 2003; 62 pp.
Report No.(s): PB2003-106171; GAO-03-753; No Copyright; Avail: CASI; A04, Hardcopy

The Department of Defense (DOD) maintains equipment and infrastructure worth billions of dollars in many environments where corrosion is causing military assets to deteriorate, shortening their useful life. The resulting increase in required repairs and replacements drives up costs and takes critical systems out of action, reducing mission readiness. GAO was asked to review military activities related to corrosion control. Specifically, this report examines the extent of the impact of corrosion on DOD and the military services and the extent of the effectiveness of DOD's and the services' approach to preventing and mitigating corrosion.
NTIS
Corrosion; Cost Reduction; Defense Program; Military Technology

20030067861 Salk Inst. for Biological Studies, San Diego, CA, USA
Inhibition of Oligo(glutamine) Precipitation by Glutamine-Containing Peptides
Chu, B. C. F.; Orgel, L. E.; Biochemical and Biophysical Research Communications; [2001]; ISSN 0006-291X; Volume 283, pp. 351-355; In English
Contract(s)/Grant(s): NAG5-4546; NAGW-8512; Copyright; Avail: Other Sources

When a solution of glutamine is added to solid 1,l' - carbonyldiimidazole, a mixture of oligo(g1utamine)s up to about the 11-mer is formed rapidly. On standing overnight, the solution deposits a precipitate that does not easily redissolve. We have studied the inhibition of this precipitation by glutamine-containing peptides. We find that the alternating peptides (arg.gln)(sub 4) and (arg.gln)(sub 8) are efficient inhibitors of precipitation while arg(sub 5), (glu.gln)(sub 4), and a nonalternating octapeptide of the same composition as (arg.gln)(sub 4) do not inhibit precipitation even though all the arg-containing peptides readily adsorb to oligo(g1utamine) precipitates. A possible structural basis for this difference is discussed.
Author
Glutamine; Oligomers; Precipitation (Chemistry); Inhibition; Polypeptides

20030067886 Scripps Institution of Oceanography, La Jolla, CA, USA
Chemical Amplification with Encapsulated Reagents
Chen, Jian; Koemer, Steffi; Craig, Stephen; Lin, Shirley; Rudkevich, Dmitry M.; Rebek, Julius, Jr.; PNAS; 5 Mar. 2002; Volume 99, No. 5, pp. 2593-2596; In English
Contract(s)/Grant(s): NAG5-4546; Copyright; Avail: CASI; A01, Hardcopy

Autocatalysis and chemical amplification are characteristic properties of living systems, and they give rise to behaviors such as increased sensitivity, responsiveness, and self-replication. Here we report a synthetic system in which a unique form of compartmentalization leads to nonlinear, autocatalytic behavior. The compartment is a reversibly formed capsule in which a reagent is sequestered. Reaction products displace the reagent from the capsule into solution and the reaction rate is accelerated. The resulting self-regulation is sensitive to the highly selective molecular recognition properties of the capsule.
Author
Reagents; Encapsulating; Reaction Kinetics; Cyclic Compounds; Molecular Structure

20030067890 Scripps Research Inst., La Jolla, CA, USA
Pentopyranosyl Oligonucleotide Systems. Part 11: Systems with Shortened Backbones: D)-beta-Ribopyranosyl-(4 yields 3)- and (L)-alpha - Lyxopyranosyl-(4 yields 3)-oligonucleotides
Wippo, Harald; Reck, Folkert; Kudick, Rene; Ramaseshan, Mahesh; Ceulemans, Griet; Bolli, Martin; Krishnamurthy, Ramanarayanan; Eschenmoser, Albert; Bioorganic & Medicinal Chemistry; 2001; ISSN 0968-0896; 9, pp. 2411-2428; In English
Contract(s)/Grant(s): NAG5-4546; Copyright; Avail: Other Sources

The (L)-a-lyxopyranosyl-(4'yields 3')-oligonucleotide system-a member of a pentopyranosyl oligonucleotide family containing a shortened backbone-is capable of cooperative base-pairing and of cross-pairing with DNA and RNA. In contrast, corresponding (D)-beta-ribopyransoyl-(4' yields 3')-oligonucleotides do not show base-pairing under similar conditions. We conclude that oligonucleotide systems can violate the six-bonds-per-backbone-unit rule by having five bonds instead, if their vicinally bound phosphodiester bridges can assume an antiperiplanar conformation. An additional structural feature that seems relevant to the cross-pairing capability of the (L)-a-lyxopyranosyl-(4' yields 3')-oligonucleotide system is its (small) backbone/basepair axes inclination. An inclination which is similar to that in B-DNA seems to be a prerequisite for an oligonucleotide system s capability to cross-pair with DNA.
Author
Deoxyribonucleic Acid; Ribonucleic Acids; Oligomers; Nucleotides; Organic Chemistry

20030067894 Scripps Institution of Oceanography, La Jolla, CA, USA
Base-Pairing Systems Related to TNA: alpha-Threofuranosyl Oligonucleotides Containing Phosphoramidate Linkages
Meyer, Michael, Technical Monitor; Wu, Xiaolin; Guntha, Sreenivasulu; Ferenclc, Mathias; Krishnamurthy, Ramanarayanan; Eschenmoser, Albert; Organic Letters; [2002]; Volume 4, No. 8, pp. 1279-1282; In English
Contract(s)/Grant(s): NAG5-4546; Copyright; Avail: Other Sources
(3'NH)- and (2'NH)-TNA, two isomeric phosphoramidate analogues of TNA (alpha-threofuranosyl-(3'-2') oligonucleotides), are shown to be efficient Watson-Crick base-pairing systems and to undergo intersystem crosspairing with TNA, RNA, and DNA.
Author
Deoxyribonucleic Acid; Oligomers; Isomers; Chemical Reactions; Nucleotides; Organic Phosphorus Compounds

20030067966 Cornell Univ., Ithaca, NY, USA, California Inst. of Tech., Pasadena, CA
Advanced Chemistry Basins Model Technical Report
Jun. 2002; 16 pp.; In English
Report No.(s): DE2003-807775; No Copyright; Avail: Department of Energy Information Bridge
The advanced Chemistry Basin Model project has been operative for 36 months. A number of tasks are reported on. The first task is to Develop a database of additional and better maturity indicators for paleo-heat flow calibration. The second task is to Develop maturation models capable of predicting the chemical composition of hydrocarbons produced by a specific kerogen as a function of maturity, heating rate, etc.; assemble a compositional kinetic database of representative kerogens. The third task of the project is to Develop a 4 phase equation of state-flash model that can define the physical properties (viscosity, density, etc.) of the products of kerogen maturation, and phase transitions that occur along secondary migration pathways. The fourth task of the project is to Build a conventional basin model and incorporate new maturity indicators and data bases in a user-friendly way. The fifth task of the project is to Develop an algorithm which combines the volume change and viscosities of the compositional maturation model to predict the chemistry of the hydrocarbons that will be expelled from the kerogen to the secondary migration pathways. The sixth task of the project is to Develop an algorithm that predicts the flow of hydrocarbons along secondary migration pathways, accounts for mixing of miscible hydrocarbon components along the pathway, and calculates the phase fractionation that will occur as the hydrocarbons move upward down the geothermal and fluid pressure gradients in the basin. The seventh and final task for the project is to Integrate the above components into a functional model implemented on a PC or low cost workstation.
NTIS
Algorithms; Hydrocarbons; Kerogen

20030067967 Cornell Univ., Ithaca, NY, USA, California Inst. of Tech., Pasadena, CA
Advanced Chemistry Basins Model Technical Report
Jun. 2001; In English
Report No.(s): DE2003-807774; No Copyright; Avail: National Technical Information Service (NTIS)
The advanced Chemistry Basin Model project has been operative for 24 months. A number of tasks are reported on. The first task is to develop a database of additional and better maturity indicators for paleo-heat flow calibration. The second task is to develop maturation models capable of predicting the chemical composition of hydrocarbons produced by a specific kerogen as a function of maturity, heating rate, etc.; assemble a compositional kinetic database of representative kerogens. The third task of the project is to develop a 4 phase equation of state-flash model that can define the physical properties (viscosity, density, etc.) of the products of kerogen maturation, and phase transitions that occur along secondary migration pathways. The

fourth task of the project is to build a conventional basin model and incorporate new maturity indicators and data bases in a user-friendly way. The fifth task of the project is to develop an algorithm which combines the volume change and viscosities of the compositional maturation model to predict the chemistry of the hydrocarbons that will be expelled from the kerogen to the secondary migration pathways. The sixth task of the project is to develop an algorithm that predicts the flow of hydrocarbons along secondary migration pathways, accounts for mixing of miscible hydrocarbon components along the pathway, and calculates the phase fractionation that will occur as the hydrocarbons move upward down the geothermal and fluid pressure gradients in the basin. The seventh and final task for the project is to integrate the above components into a functional model implemented on a PC or low cost workstation.
NTIS
Petrology; Algorithms; Hydrocarbons

20030067969 Cornell Univ., Ithaca, NY, USA, California Inst. of Tech., Pasadena, CA
Advanced Chemistry Basins Model Technical Report
Blanco, M.; Cathles, L.; Manhardt, P.; Meulbroek, P.; Tang, Y.; 2001; 12 pp.; In English
Report No.(s): DE2003-807776; No Copyright; Avail: Department of Energy Information Bridge

The advanced Chemistry Basin Model project has been operative for 30 months. A number of tasks are reported on. The first task is to Develop a database of additional and better maturity indicators for paleo-heat flow calibration. The second task is to Develop maturation models capable of predicting the chemical composition of hydrocarbons produced by a specific kerogen as a function of maturity, heating rate, etc.; assemble a compositional kinetic database of representative kerogens. The third task of the project is to Develop a 4 phase equation of state-flash model that can define the physical properties (viscosity, density, etc.) of the products of kerogen maturation, and phase transitions that occur along secondary migration pathways. The fourth task of the project is to Build a conventional basin model and incorporate new maturity indicators and data bases in a user-friendly way. The fifth task of the project is to Develop an algorithm which combines the volume change and viscosities of the compositional maturation model to predict the chemistry of the hydrocarbons that will be expelled from the kerogen to the secondary migration pathways. The sixth task of the project is to Develop an algorithm that predicts the flow of hydrocarbons along secondary migration pathways, accounts for mixing of miscible hydrocarbon components along the pathway, and calculates the phase fractionation that will occur as the hydrocarbons move upward down the geothermal and fluid pressure gradients in the basin. The seventh and final task for the project is to Integrate the above components into a functional model implemented on a PC or low cost workstation.
NTIS
Algorithms; Kerogen; Hydrocarbons

20030067972 Scripps Research Inst., La Jolla, CA, USA
Pentopyranosyl Oligonucleotide Systems
Wagner, Thomas; Huyuh, Hoan K.; Krishnamurthy, Ramanarayanan; Eschenmoser, Albert; Helvetica Chimica Acta; 2002; Volume 85, pp. 399-416; In English
Contract(s)/Grant(s): NAG5-4546; Copyright; Avail: Other Sources

Beta-D-Xylopyranosyl-(4 - 2)-oligonucleotides containing adenine and thymine as nucleohases were synthesized as a part of a systematic study of the pairing properties of pentopyranosyl oligonucleotides. Contrary to earlier expectations based on qualitative conformational criteria, Beta-D-xylopyranosyl(4 - 2)- oligonucleotides show Watson-Crick pairing comparable in strength to that shown by pyranosyl-RNA.
Author
Ribonucleic Acids; Adenines; Thymine; Nucleotides; Synthesis (Chemistry)

20030068007 Swedish Defence Research Establishment, Tumba, QinetiQ Ltd., Farnborough, UK
N(4) Project. Annual Report for the Year 2001
Oestmark, H.; Bittererova, M.; Brinck, T.; Hore, N.; Claridge, R.; May 2002; In English
Report No.(s): PB2003-103238; FOI-R-0364-SE; No Copyright; Avail: National Technical Information Service (NTIS)

During 2001, the main efforts within the N4 project have been concentrated to electric discharge excitation, ion-bombarding and microwave excitation and a-particle excitation experiments on cryogenic nitrogen-containing matrices in two different cryostats. Several synthesis attempts have been made using long integration times in order to suppress random noise. Temperature-controlled experiments have been performed on products from microwave discharge, condensed on a sapphire window in a small cryostat. A time-of-flight mass spectrometer has been used for laser decomposition experiments

on high-nitrogen compounds, previously synthesized and characterized through Raman spectroscopy. Initial capillary experiments of liquid nitrogen with multiphoton excitation have been performed at 222.7 nm. SERS (Surface-Enhanced Raman Spectroscopy) experiments have been carried out on previously known substances, including P4(Td). A vacuum ultraviolet system has been set up for matrix emission studies in the 120-200 nm range. Extensive theoretical calculations have been performed in order to locate new synthesis and detection pathways for N4(Td) and N4(D2h).
NTIS
Explosives; Liquid Nitrogen

20030068012 Scripps Research Inst., La Jolla, CA, USA, Eidgenoessische Technische Hochschule, Zurich, Switzerland
Pentopyranosyl Oligonucleotide Systems
Reck, Folkert; Kudick, Rene; Krishnamurthy, Ramanarayanan; Eschenmoser, Albert; Wippo, Harald; Helvetica Chimica Acta; 2001; Volume 84, pp. 1778-1804; In English
Contract(s)/Grant(s): NAG5-4546; Copyright; Avail: Other Sources

To determine whether the remarkable chemical properties of the pyranosyl isomer of RNA as an informational Watson-Crick base-pairing system are unique to the pentopyranosyl-(4 + 2)-oligonucleotide isomer derived from the RNA-building block D-ribose, studies on the entire family of diastereoisomeric pyranosyL(4 - Z)-oligonucleotide systems deriving from D-ribose. L-lyxose. D-xylose, and L-arabinose were carried out. The result of these extended studies is unambiguous: not only pyranosyl-RNA, but all members of the pentopyranosyl(4 + 2)-oligonucleotide family are highly efficient Watson-Crick base-pairing systems. Their synthesis and pairing properties will be described in a series of publications in this journal.
Author
Ribonucleic Acids; Isomers; Synthesis (Chemistry); Nucleotides

20030068041 Scripps Research Inst., La Jolla, CA, USA
A Self-Replicating Ligase Ribozyme
Paul, Natasha; Joyce, Gerald F.; PNAS; October 2002; Volume 99, No. 20, pp. 12733-12740; In English
Contract(s)/Grant(s): NAG5-9386; Copyright; Avail: Other Sources

A self-replicating molecule directs the covalent assembly of component molecules to form a product that is of identical composition to the parent. When the newly formed product also is able to direct the assembly of product molecules, the self-replicating system can be termed autocatalytic. A self-replicating system was developed based on a ribozyme that catalyzes the assembly of additional copies of Itself through an RNA-catalyzed RNA ligation reaction. The R3C ligase ribozyme was redesigned so that it would ligate two substrates to generate an exact copy of itself, which then would behave in a similar manner. This self-replicating system depends on the catalytic nature of the RNA for the generation of copies. A linear dependence was observed between the initial rate of formation of new copies and the starting concentration of ribozyme, consistent with exponential growth. The autocatalytic rate constant was 0.011 per min, whereas the initial rate of reaction in the absence of pre-existing ribozyme was only 3.3 x 10(exp -11) M per min. Exponential growth was limited, however, because newly formed ribozyme molecules had greater difficulty forming a productive complex with the two substrates. Further optimization of the system may lead to the sustained exponential growth of ribozymes that undergo self-replication.
Author
Enzymes; Autocatalysis; Ribonucleic Acids

20030068042 Scripps Institution of Oceanography, La Jolla, CA, USA
Direct Isolation of Purines and Pyrimidines from Nucleic Acids Using Sublimation
Glavin, Daniel P.; Schubert, Michael; Bada, Jeffrey L.; [2003]; 5 pp.; In English
Contract(s)/Grant(s): NAG5-4546; Copyright; Avail: Other Sources

A sublimation technique was developed to isolate purines and pyrimidines directly from lambda-deoxyribonucleic acid (lambda-DNA) and Escherichia coli cells. The sublimation of adenine, cytosine, guanine, and thymine from lambda-DNA was tested under reduced pressure (approx. 0.5 Torr) at temperatures of >150 C. With the exception of guanine, approximately 60 -75% of each base was sublimed directly from the lambda-DNA and recovered on a coldfinger of the sublimation apparatus after heating to 450 C. Several nucleobases including adenine, cytosine, thymine, and uracil were also recovered from E. coli bacteria after heating the cells to the same temperature, although some thermal decomposition of the bases also occurred.

These results demonstrate the feasibility of using sublimation to isolate purines and pyrimidines from native E. coli DNA and RNA without any chemical treatment of the cells.
Author
Purines; Pyrimidines; Deoxyribonucleic Acid; Ribonucleic Acids; Sublimation

20030068095 Florida Univ., Gainesville, FL
Identification and Synthesis of High Nitrogen Propellants
Bartlett, Rodney J.; Aug. 31, 2002; 7 pp.; In English
Contract(s)/Grant(s): F49620-98-1-0477
Report No.(s): AD-A415159; AFRL-SR-AR-TR-03-0217; No Copyright; Avail: CASI; A02, Hardcopy

(SOME HIGHLIGHTS OF OUR RECENT WORK - = Provided the reference theoretical results required in the identification of the transient N4 Molecule5. = Developed new coupled-cluster methods for obtaining accurate Raman intensities, which are crucial to the identification of many polynitrogen species 6. = Showed that it is unlikely to be able to synthesize N4 with only one of two molecules excited Both need to be excited into either triplet or quintet states and caused to collide 9 = Demonstrated that an ionic lattice composed of N5 + and N3- is not likely to exist 8. = Proposed that the next target for the DARPA program should be to synthesize the pentazole anion, N5-, the inorganic benzene' 4, 6. =Predicted the properties of the pentazole anion using our high level couple-cluster methods, including its energetics, structure, vibrational frequencies, and IR and Raman intensities, and its UV-vis (electronic excited state) spectrum 6. Suggested that N5+ and N5- are likely to be able to co-exist in an ionic lattice, further recommending the synthesis of the anion 10. =Performed a large number of high level quantum chemical calculations to survey all stable purely nitrogen species, from N2 to Nl0 and some larger species, their cations and anions. We provide the vibrational frequencies, IR and Raman intensities for all, and for selected molecules, excited and ionized state information. This information is collected into a Compendium that can be downloaded from my web page 11. =Recommended that we seriously consider synthesis of the N6O3 molecule, which by virtue of its three coordinate covalent bonds to oxygen, permits the long sough N6 pseudo-benzene ring to form. We report detailed studies of its activation barrier and properties in a recent paper 12.
DTIC
Molecules; Nitrogen; Propellants

20030068125 BAE Systems, Huntsville, AL, USA, NASA Marshall Space Flight Center, Huntsville, AL, USA
Gibbs-Thomson Law for Singular Step Segments: Thermodynamics Versus Kinetics
Chernov, A. A.; [2003]; 1 pp.; In English
Contract(s)/Grant(s): NAS8-02096; No Copyright; Avail: Other Sources; Abstract Only

Classical Burton-Cabrera-Frank theory presumes that thermal fluctuations are so fast that at any time density of kinks on a step is comparable with the reciprocal intermolecular distance, so that the step rate is about isotropic within the crystal plane. Such azimuthal isotropy is, however, often not the case: Kink density may be much lower. In particular, it was recently found on the (010) face of orthorhombic lysozyme that interkink distance may exceed 500-600 intermolecular distances. Under such conditions, Gibbs-Thomson law (GTL) may not be applicable: On a straight step segment between two corners, communication between the comers occurs exclusively by kink exchange. Annihilation between kinks of opposite sign generated at the comers results in the grain in step energy entering GTL. If the step segment length l much greater than D/v, where D and v are the kink diffusivity and propagation rate, respectively, the opposite kinks have practically no chance to annihilate and GTL is not applicable. The opposite condition of the GTL applicability, l much less than D/v, is equivalent to the requirement that relative supersaturation Delta(sub mu)/kT much less than alpha/l, where alpha is molecular size. Thus, GTL may be applied to a segment of 10(exp 3)alpha approx. 3 x 10(exp -5)cm approx 0.3 micron only if supersaturation is less than 0.1%, while practically used driving forces for crystallization are much larger. Relationships alternative to the GTL for different, but low, kink density have been discussed. They confirm experimental evidences that the Burton-Cabrera-Frank theory of spiral growth is growth rates twice as low as compared to the observed figures. Also, application of GTL results in unrealistic step energy while suggested kinetic law give reasonable figures.
Author
Thermodynamics; Kinetics; Supersaturation; Crystallization

20030068154 National Inst. of Standards and Technology, Gaithersburg, MD, Warsaw Univ., Warsaw, Poland
Ultrasonic Evaluation Methods Applicable to Polymer Concrete Composites
Garboczi, E. J.; Garbaczi, A.; Apr. 2003; 84 pp.; In English
Report No.(s): PB2003-104546; NISTIR-6975; No Copyright; Avail: CASI; A05, Hardcopy

Polymer composites (PC) appear as useful materials for repair and protection of building structures, as well as for manufacturing pre-cast elements. In the case of pre-cast elements, as well as repair materials, the usefulness and durability of polymer composites depend on the selection of the material composition for obtaining the composite with controllable properties. This task is a material design and optimization procedure. For repairs and protective coatings, the main problem is good bonding between PC composites and concrete substrate for the length of time desired. In both cases, there is a need for quality control (verification tests) and diagnostic tests during structural service as well. This is available using destructive or semi-destructive tests. The results of the project confirmed the usefulness of ultrasonic methods for nondestructive evaluation of polymer concrete composites in various applications. The pulse velocity method can be used for evaluation of the properties and homogeneity of the pre-cast elements made from polymer concrete as well as for evaluation of adhesion in the multi-layer PC-CC systems (adhesion mapping). The ultrasonic echo method can be used as a complementary method for nondestructive estimation of PC layer thickness.
NTIS
Concretes; Ultrasonics; Polymers; Manufacturing; Composite Materials

20030068189 Brookhaven National Lab., Upton, NY
Multi-Element Si Sensor with Readout Asic for EXAFS Spectroscopy
De Geonimo, G.; OConner, P.; Beuttenmuller, R. H.; Li, Z.; Kuczewski, A. J.; Sep. 2002; 11 pp.; In English
Report No.(s): DE2003-807518; BNL-69451; No Copyright; Avail: Department of Energy Information Bridge

Extended X-ray Absorption Fine Structure (EXAFS) experiments impose stringent requirements on a detection system, due to the need for processing ionizing events at a high rate, typically above of 10Mcps/cm2, and with a high resolution, typically better than 300eV. The detection system here presented is being developed targeting these stringent requirements. It is the result of a cooperation between the Instrumentation Division and the National Synchrotron Light Source (NSLS) of the Brookhaven National Laboratoiy (BNL). The system is composed of a multi-element Si sensor with dedicated per pixel electronics. The combination of high rate, high resolution and moderate complexity makes this system attractive when compared to other multi-element solutions. In sections 2, 3 and 4 the sensor, the interconnect and the electronics are briefly described. Section 5 reports on the first experimental results.
NTIS
Silicon; X Ray Spectroscopy; High Resolution; Integrated Circuits

20030068307 Salk Inst. for Biological Studies, San Diego, CA, USA
The Synthesis of Beta-Peptides Containing Guanidino Groups
Wen, Ke; Han, Hyunsoo; Hoffman, Timothy Z.; Janda, Kim D.; Orgel, Leslie E.; Bioorganic and Medicinal Chemistry Letters; [2003]; ISSN 0960-894X; Volume 11, pp. 689-691; In English
Contract(s)/Grant(s): NAG5-4546; Copyright; Avail: Other Sources

The synthesis of the beta-peptide 1 by the postsynthetic modification of the corresponding amino-containing peptide 3 is described. The potential of 1 to act as a template for the ligation of complementary negatively-charged peptides is discussed.
Author
Peptides; Synthesis (Chemistry); Guanidines; Oligomers; Molecular Structure

20030068312 Universidad Nacional Autonoma de Mexico, Mexico City, Mexico
The 1953 Stanley L. Miller Experiment: Fifty Years of Prebiotic Organic Chemistry
Lazcano, Antonio; Bada, Jeffrey L.; Origins of Life and Evolution of the Biosphere; [2003]; Volume 33, pp. 235-242; In English
Contract(s)/Grant(s): NAG5-4546; Copyright; Avail: Other Sources

The field of prebiotic chemistry effectively began with a publication in Science 50 years ago by Stanley L. Miller on the spark discharge synthesis of amino acids and other compounds using a mixture of reduced gases that were thought to represent the components of the atmosphere on the primitive Earth. On the anniversary of this landmark publication, we provide here an accounting of the events leading to the publication of the paper. We also discuss the historical aspects that lead up to the landmark Miller experiment.
Author
Organic Chemistry; Atmospheres; Synthesis (Chemistry); Electric Sparks

20030068337 Scripps Research Inst., La Jolla, CA, USA

Amplification by Compartmentalization

Chen, Jian; Korner, Steffi; Rudkevich, Dmitry M.; Rebek, Julius, Jr.; Craig, Stephen L.; NATURE; [2003]; Volume 415, pp. 385-386; In English

Contract(s)/Grant(s): NAG5-4546; Copyright; Avail: Other Sources

Autocatalysis and chemical amplification are properties of living systems that can lead to increased responsiveness and to self-replication. Here we describe a synthetic system in which a unique form of reagent compartmentalization gives rise to nonlinear kinetics that are subject to the precise size- and shape-selectivity of the host. The reactivity is reminiscent of autocatalytic behavior, in which there is no direct contact between reagents and products, and our approach offers a general way to impose complex chemical behaviour onto synthetic systems.

Author

Chemical Reactions; Synthesis (Chemistry); Reagents

20030068421 Scripps Research Inst., La Jolla, CA, USA

Continuous In Vitro Evolution of a Ribozyme that Catalyzes Three Successive Nucleotidyl Addition Reactions

McGinness, Kathleen E.; Wright, Martin C.; Joyce, Gerald F.; Chemistry and Biology; [2002]; ISSN 1074-5521; Volume 9, pp. 585-596; In English

Contract(s)/Grant(s): NAG5-4546; Copyright; Avail: Other Sources

Variants of the class I ligase ribozyme, which catalyzes joining of the 3' end of a template bound oligonucleotide to its own 5' end, have been made to evolve in a continuous manner by a simple serial transfer procedure that can be carried out indefinitely. This process was expanded to allow the evolution of ribozymes that catalyze three successive nucleotidyl addition reactions, two template-directed mononucleotide additions followed by RNA ligation. During the development of this behavior, a population of ribozymes was maintained against an overall dilution of more than 10(exp 406). The resulting ribozymes were capable of catalyzing the three-step reaction pathway, with nucleotide addition occurring in either a 5' yieldig 3' or a 3' yielding 5' direction. This purely chemical system provides a functional model of a multi-step reaction pathway that is undergoing Darwinian evolution.

Author

Catalytic Activity; Chemical Reactions; In Vitro Methods And Tests; Nucleotides; Oligomers; Ribonucleic Acids

20030068528 Chongqing Univ., China

Electrochemical Oxidation of Phenol at Carbon Nanotube Electrode

Hu, C. G.; Wang, W. L.; Liao, K. J.; Xian, X. H.; Feng, Q.; Liu, G. B.; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 90-94; In English; See also 20030068525; No Copyright; Avail: CASI; A01, Hardcopy

The carbon nanotubes synthesized by hot-filament chemical vapor deposition were modified by concentrated nitric acid with a little surfactant. The electrochemical oxidation of phenol at the carbon nanotube electrode has been studied in phosphate buffer solution by cyclic voltammetry. The results showed that the direct electron transfer reactions on the carbon nanotube electrode surface could occur in the potential region of water stability, which resulted in the active groups on the carbon nanotubes due to the chemical modification. The well defined and reproductive oxidation peaks at 0.73 V vs. SCE, scan rate 50 mV/s were clearly observed at the carbon nanotube electrode, which indicated that the electrode could avoid electrode fouling. The reaction process was controlled by diffusion process. The anodic peak current increased linearly with the concentration of phenol in the range of 1.0 x 10(exp -5)-1.0 x 10(exp -4) mol/L in cyclic voltammetric measurement. The electrochemical oxidation of phenol was also carried out on a fresh polished GC electrode for comparison, which did not have well defined oxidation peak and peak current decayed rapidly down with the every cycle. The mechanism of oxidation was discussed in details.

Author

Vapor Deposition; Synthesis (Chemistry); Carbon Nanotubes; Surfactants; Nitric Acid; Electron Transfer; Electrochemical Oxidation

20030068594 Chongqing Univ., China

Kinetics Study Of Cd(2+) Ions In Sodium Sulfate Solution at Carbon Nanotube Electrode

Hu, C. G.; Wang, W. L.; Liao, K. J.; Xian, X. H.; Wang, H.; Proceedings of the Seventh Applied Diamond Conference/Third

Frontier Carbon Technology Joint Conference; August 2003, pp. 53-58; In English; See also 20030068525; No Copyright; Avail: CASI; A02, Hardcopy

The electrochemical response to Cd(2+) ions on an electrode of carbon nanotubes functionalized with carboxylic acid group was studied mainly by use of cyclic voltammetry in aqueous sodium sulfate. A well-defined quasi-reversible voltammograms for the Cd(2+)/Cd redox couple were shown on the carbon nanotube electrode, and the anodic and cathodic peak potentials were .0.67 V and .0.92 V vs. SCE at a scan rate of 50 mV/s, respectively. Both anodic and cathodic peak currents depended linearly on the square root of the scan rate over the range of 0.05-0.8 V/s. Such linearity indicated that the reaction rate was limited by semi-infinite linear diffusion of the analyte to the interfacial reaction zone. The electron-transfer and diffusion coefficients for Cd(2+)/Cd were evaluated from the dependence of the voltammograms on the potential scan rate and concentration of analyte.

Author

Carbon Nanotubes; Electrodes; Chemical Reactions; Cadmium; Sodium Sulfates; Electron Transfer; Ions

20030068615 Fraunhofer-Inst. fuer Schicht- und Oberflaechentechnik, Brunswick, Germany

Electrochemical Advanced Oxidation Process for Water Treatment Applications

Fryda, Matthias; Matth, Thorsten; Mulcahy, Shane; Scher, Lothar; Ger, Markus; Tter, Inga; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 128; In English; See also 20030068525; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

The unique electrochemical properties exhibited by boron doped diamond films are such that new and improved electrochemical processes may now be explored both at laboratory and industrial scale. The coating of a conventional electrode material with a boron doped diamond film results in the realization of an electrode which not only is extremely chemically stable but one which opens up the widest known electrochemical window before water decomposition takes place. The stability of DiaChem electrodes has been proven through the loading of the electrodes with increasing current densities of up to several A/square centimeters in sulfuric acid. The electrochemical generation of oxidants used for the recovery or treatment of wastewaters from industrial plants by electrochemical oxidation processes is playing an ever increasing role due to their reliable operating conditions and ease of handling. For example decomposition of cooling fluid in water has been investigated. It has been clearly shown that within the boundary of measurement accuracy it is possible to completely mineralize any organic carbon present. Long chain organic molecules such as cooling fluid may be mineralized from hydroxyl radicals without the development of intermediate products. EAOP pilot cells as shown in fig. 3 are presently in use in a number of applications from the industrial waste water treatment to water recycling for the optics industry. These tests have displayed excellent results with regards to energy efficiency and effectiveness. It has been demonstrated that it is possible to achieve COD reduction for water flow rates of up to 200l/hour.

Author

Electrochemical Oxidation; Waste Water; Water Treatment; Electrochemistry; Diamond Films

20030068658 Nanyang Technological Univ., Nanyang, Singapore

Fluorinated Amorphous Diamond Like Carbon Films by PECVD

Yu, G. Q.; Tay, B. K.; Sun, Z.; Lau, S. P.; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 451-459; In English; See also 20030068525; Original contains color illustrations; No Copyright; Avail: CASI; A02, Hardcopy

Fluorinated amorphous diamond-like carbon films (a-C:F) were prepared on room-temperature (100) Si substrates using radio frequency plasma enhance chemical vapor deposition (rf PECVD) by varying the ratio of carbon tetrafluoride and methane (CF4:CH4).The films formed were investigated in terms of the surface morphology, chemical composition, microstructure, mechanical properties, and surface free energy by means of atomic force microscopy (AFM), x-ray photoelectron spectrum (XPS), micro-scratch test, nano-indenter test and contact angle measurement. It was observed that with increasing CF4:CH4, the roughness and F content of the a-C:F films increased while the hardness, Young.s modulus and surface energy decreased. The microstructure of the films also changed from diamond-like to graphite-like. The reduction of the film surface energy with varying F content is believed to be mainly due to the change of bonds in the film, i.e., the decrease of -C-CF bond and corresponding increase of .CF, -CF2, as evidenced by XPS results.

Author

Amorphous Materials; Carbon; Diamond Films; Photoelectron Spectroscopy; Vapor Deposition; Mechanical Properties

20030068695 Komatsu (Tamikuni), Tsukuba, Japan

Chemical Synthesis of Graphite-Like B/C/N Materials Leading to the Shock Synthesis of the Heterodiamond

Komatsu, Tamikuni; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 383-386; In English; See also 20030068525; No Copyright; Avail: CASI; A01, Hardcopy

Graphite-like B/C/N materials, g-BCxN, are chemically prepared in very high yields using a polymer pyrolysis system of boron trichloride and commercially available N-containing materials such as tetracyanoethylene and polyacrylonitrile. Using the g-BCxN materials, a series of new diamond materials, B/C/N heterodiamond, are shock-synthesized.The Lewis acid-base reaction initially occurs between BCl3 gas and the basic organic compounds, is followed by polymerization, carbonization and heat-treatment. The g-BCxN materials over the almost entire range of compositions can be prepared: the g-BC3N material is obtained in ca. 75 % yield from polyacrylonitrile, and the g-BC4N is in nearly 100 % yield from tetracyanoethylene. The materials have a miscible blend (hybrid) structure consisting of CNx and (BN)y segments and have turbostatic hexagonal structures similar to the structure of the chemical vapor deposition g-BC2N. The g-BCxN materials obtained are explosively shock-compressed and successfully phase-transformed into their almost allotropic heterodiamond materials.

Author

Boron Carbides; Boron Nitrides; Synthesis (Chemistry)

26
METALS AND METALLIC MATERIALS

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

20030067690 Army Armament Research, Development and Engineering Center, Watervliet, NY

Thermal Damage, Cracking, and Rapid Erosion of Cannon Bore Coatings

Underwood, John H.; Parker, Anthony P.; Vigilante, Gregory N.; Cote, Paul J.; Mar. 2003; 22 pp.; In English

Report No.(s): AD-A414630; ARCCB-TR-03004; No Copyright; Avail: CASI; A03, Hardcopy

Thermal damage observed at the bore of fired cannons has increased noticeably in the past decade, due to the use of higher combustion gas temperatures for improved cannon performance. Current authors and coworkers recently have described cannon firing damage and proposed new thermomechanical models to gain understanding of its causes, with emphasis on the severe damage that occurs in the steel beneath the chromium plating used to protect the cannon bore. Recent refinements in the models will be used here to characterize some additional damage observations in the area beneath the protective coating of fired cannons. Model results validated by microstructural observations give predictions of near-bore temperature and stress distributions and good agreement with observed depths of hydrogen cracking in the high-strength steel substrate. Interest in damage and failure within a coating is also of concern for cannons, since coating failure leads to extremely rapid erosion of coating and substrate. The slip-zone model of Evans and Hutchinson is adapted here to predict future strength of cannon coatings based on observed crack spacing and microhardness of thermally damaged areas. Results are described for electroplated chromium coatings from fired cannons and for sputtered chromium and tantalum coatings with laser-heating damage to simulate firing. Coating mechanics analysis of fired and laser-heated samples provides an in-situ measurement of coating failure strength, showing that sputtered chromium has more than twice the failure strength of electroplated chromium. An analysis of cyclic shear failure of a coating interface at an open crack shows a six-fold decrease in low-cycle fatigue life compared to the life of a closed crack. Recommendations are given for preventing rapid coating failure and catastrophic erosion of fired cannons, with emphasis on methods to prevent deep, open cracks in coating and substrate.

DTIC

Damage; Protective Coatings; Guns (Ordnance)

20030067932 Army Research Lab., Hampton, VA, USA, NASA Langley Research Center, Hampton, VA, USA

Near-Threshold Fatigue Crack Growth Behavior of Fine-Grain Nickel-Based Alloys

Newman, John A.; Piascik, Robert S.; August 2003; 13 pp.; In English

Contract(s)/Grant(s): RTOP 23-762-30-71

Report No.(s): NASA/TM-2003-212443; NAS 1.15:212443; L-18314; ARL-TR-3021; No Copyright; Avail: CASI; A03, Hardcopy

Constant-Kmax fatigue crack growth tests were performed on two finegrain nickel-base alloys Inconel 718 (DA) and Ren 95 to determine if these alloys exhibit near-threshold time-dependent crack growth behavior observed for fine-grain aluminum alloys in room-temperature laboratory air. Test results showed that increases in K(sub max) values resulted in increased crack

growth rates, but no evidence of time-dependent crack growth was observed for either nickel-base alloy at room temperature. Author

Crack Propagation; Fatigue (Materials); Nickel Alloys; Microstructure; Aluminum Alloys; Granular Materials

20030067945 NASA Langley Research Center, Hampton, VA, USA, Army Research Lab., Hampton, VA, USA

Characterization of Cracking and Crack Growth Properties of the C5A Aircraft Tie-Box Forging

Piascik, Robert S.; Smith, Stephen W.; Newman, John A.; Willard, Scott A.; August 2003; 36 pp.; In English

Contract(s)/Grant(s): 706-62-31-51

Report No.(s): NASA/TM-2003-212439; L-18309; NAS 1.15:212439; ARL-TR-3046; No Copyright; Avail: CASI; A03, Hardcopy

Detailed destructive examinations were conducted to characterize the integrity and material properties of two aluminum alloy (7075-T6) horizontal stabilizer tie box forgings removed.from US. Air Force C5A and C5B transport aircraft. The C5B tie box forging was,found to contain no evidence of cracking. Thirteen cracks were found in the CSA,forging. All but one of the cracks observed in the C5A component were located along the top cap region (one crack was located in the bottom cap region). The cracks in the C5A component initiated at fastener holes and propagated along a highly tunneled intergranular crack path. The tunneled crack growth configuration is a likelv result of surface compressive stress produced during peening of the .forging suijace. The tie box forging ,fatigue crack growth, fracture and stress corrosion cracking (SCC) properties were characterized. Reported herein are the results of laboratory air ,fatigue crack growth tests and 95% relative humidity SCC tests conducted using specimens machined from the C5A ,forging. SCC test results revealed that the C5A ,forging material was susceptible to intergranular environmental assisted cracking: the C5A forging material exhibited a SCC crack-tip stress-intensity factor threshold of less than 6 MPadn. Fracture toughness tests revealed that the C5A forging material exhibited a fracture toughness that was 25% less than the C5B forging. The C5A forging exhibited rapid laboratory air fatigue crack growth rates having a threshold crack-tip stress-intensity factor range of less than 0.8 MPa sup m. Detailed fractographic examinations revealed that the ,fatigue crack intergranular growth crack path was similar to the cracking observed in the C5A tie box forging. Because both fatigue crack propagation and SCC exhibit similar intergranular crack path behavior, the damage mechanism resulting in multi-site cracking of tie box forgings cannot be determined unless local cyclic stresses can be quantified.

Author

Mechanical Properties; Crack Propagation; Cracking (Fracturing); C-5 Aircraft; Forging

20030067948 NASA Langley Research Center, Hampton, VA, USA

Micromechanics Modeling of Fracture in Nanocrystalline Metals

Glaessgen, E. H.; Piascik, R. S.; Raju, I. S.; Harris, C. E.; [2002]; 8 pp.; In English; 43rd AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics and Materials Conference, 22-25 Apr. 2002, Denver, CO, USA

Report No.(s): AIAA Paper 2002-1315; Copyright; Avail: CASI; A02, Hardcopy

Nanocrystalline metals have very high theoretical strength, but suffer from a lack of ductility and toughness. Therefore, it is critical to understand the mechanisms of deformation and fracture of these materials before their full potential can be achieved. Because classical fracture mechanics is based on the comparison of computed fracture parameters, such as stress intlmsity factors, to their empirically determined critical values, it does not adequately describe the fundamental physics of fracture required to predict the behavior of nanocrystalline metals. Thus, micromechanics-based techniques must be considered to quanti@ the physical processes of deformation and fracture within nanocrystalline metals. This paper discusses hndamental physicsbased modeling strategies that may be useful for the prediction Iof deformation, crack formation and crack growth within nanocrystalline metals.

Author

Fracture Mechanics; Deformation; Crack Propagation; Metals

20030068049 WISCONSIN UNIV-MADISON OFFICE OF RESEARCH ADMINISTRATION, Madison, WI, USA

Phase Stability and Microstructure Control in High Temperature (Mo,Nb)-Si-B Alloys

Perepezko, John H.; Jan. 4, 2003; 31 pp.; In English

Contract(s)/Grant(s): F49620-00-1-0077

Report No.(s): AD-A415030; AFRL-SR-AR-TR-03-0207; No Copyright; Avail: CASI; A03, Hardcopy

The challenges of a high temperature environment (T less than 1400 C) impose severe material performance constraints in terms of melting point, oxidation resistance and structural functionality. A number of ceramic materials, intermetallic

compounds and refractory metals with high melting temperature are available as material choices. However, in a single component, single phase form, these materials rarely satisfy all the above requirements because of the brittleness of ceramic materials and intermetallic compounds at low temperatures and the oxidation problems and poor creep resistance of refractory metals at high temperatures. In this respect the evolutionary development of high temperature alloys over the past 4-5 decades represents a remarkable achievement and provides important lessons to guide future materials design efforts. One clear message is the importance of multiphase microstructures and the capability to control phase fractions and morphologies within the overall structure 87Sto, 87Ros,90Dys. The flexibility in microstructure control has been shown to be critical in tailoring alloy performance in order to satisfy a number of mechanical property requirements that sometimes present conflicting demands 92Dim, 9lKim. Besides the essential structural requirements, elevated temperatures also often involve aggressive environments that require a material to display an inherent oxidation protection that can be enhanced further by coating 79Mai.
DTIC
Heat Resistant Alloys; High Temperature Environments; Stability; Silicon Alloys; Ceramics

20030068107 NASA Glenn Research Center, Cleveland, OH, USA
The Effect of Stabilization Treatments on Disk Alloy CH98
Gayda, John; Gabb, Timothy P.; Ellis, David L.; August 2003; 18 pp.; In English
Contract(s)/Grant(s): WU-538-12-40
Report No.(s): NASA/TM-2003-212475; E-14013; NAS 1.15:212475; No Copyright; Avail: CASI; A03, Hardcopy

Gas turbine engines for future subsonic transports will probably have higher pressure ratios which will require nickelbase superalloy disks with 1300 to 1400 F temperature capability. Several advanced disk alloys are being developed to fill this need. One of these, CH98, is a promising candidate for gas turbine engines and is being studied in NASA s Advanced Subsonic Technology (AST) program. For large disks, residual stresses generated during quenching from solution heat treatments are often reduced by a stabilization heat treatment, in which the disk is heated to 1500 or 1600 F for several hours followed by a static air cool. The reduction in residual stress levels lessens distortion during machining of disks. However, previous work on CH98 has indicated that stabilization treatments can also decrease creep capability. In this study, a systematic variation of stabilization temperature and time was investigated to determine its effect on 1300 F tensile and, more importantly, creep behavior. Dwell crack growth rates were also measured for selected stabilization conditions. As these advanced disk alloys may be given a supersolvus solution or a subsolvus solution heat treatment for a given application, it was decided that both options would be studied.
Author
Heat Resistant Alloys; Gas Turbine Engines; Residual Stress; Creep Properties

20030068128 NASA Glenn Research Center, Cleveland, OH, USA
The Effect of Tungsten and Niobium on the Stress Relaxation Rates of Disk Alloy CH98
Gayda, John; August 2003; 13 pp.; In English
Contract(s)/Grant(s): WU-538-12-40
Report No.(s): NASA/TM-2003-212472; E-14010; NAS 1.15:212472; No Copyright; Avail: CASI; A03, Hardcopy

Gas turbine engines for future subsonic transports will probably have higher pressure ratios which will require nickel-base superalloy disks with 1300 to 1400 F temperature capability. Several advanced disk alloys are being developed to fill this need. One of these, CH98, is a promising candidate for gas turbine engines and is being studied in NASA s Advanced Subsonic Technology (AST) program. For large disks, residual stresses generated during quenching from solution heat treatment are often reduced by a stabilization heat treatment, in which the disk is heated to 1500 to 1600 F for several hours followed by a static air cool. The reduction in residual stress levels lessens distortion during machining of disks. However, previous work on CH98 has indicated that stabilization treatments decrease creep capability. Additions of the refractory elements tungsten and niobium improve tensile and creep properties after stabilization, while maintaining good crack growth resistance at elevated temperatures. As the additions of refractory elements increase creep capability, they might also effect stress relaxation rates and therefore the reduction in residual stress levels obtained for a given stabilization treatment. To answer this question, the stress relaxation rates of CH98 with and without tungsten and niobium additions are compared in this paper for temperatures and times generally employed in stabilization treatments on modern disk alloys.
Author
Nickel Alloys; Creep Properties; Crack Propagation; Tensile Properties

20030068138 NASA Glenn Research Center, Cleveland, OH, USA

The Effect of Tungsten and Niobium Additions on Disk Alloy CH98

Gayda, John; August 2003; 16 pp.; In English; Original contains black and white illustrations

Contract(s)/Grant(s): WU-538-06-13

Report No.(s): NASA/TM-2003-212471; E-14009; NAS 1.15:212471; No Copyright; Avail: CASI; A03, Hardcopy

Gas turbine engines for future subsonic transports will probably have higher pressure ratios which will require nickelbase superalloy disks with 1300 F to 1400 F temperature capability. Several advanced disk alloys are being developed to fill this need. One of these, CH98, is a promising candidate for gas turbine engines and is being studied in NASA's AST Program. For AST applications, compressor/turbine disks must withstand temperatures of 1300 F for several hundred hours over the life of the engine. Additions of the refractory elements tungsten and niobium to CH98 could improve tensile and creep properties, however, the impact on high temperature fatigue crack growth is uncertain. In this paper, these three key properties, tensile, 0.2 percent creep, and fatigue crack growth of CH98 with and without tungsten and niobium additions will be assessed at l300 F.

Author

Gas Turbine Engines; Nickel Alloys

20030068178 Canada Centre for Mineral and Energy Technology, Ottawa, Ontario, Canada

Cold Work Embrittlement of Interstitial Free Steel

Martin, P.; Bowker, J. T.; 2002; 151 pp.; In English

Report No.(s): DE2003-805761; No Copyright; Avail: Department of Energy Information Bridge

This work addresses the issues of measurement of secondary cold work embrittlement (SCWE) of an IF steel in deep-drawn parts using laboratory tests, and its correlation with real part fracture. It aimed at evaluating the influence of the steel chemistry and processing condition, microstructure, and test conditions, on SCWE as well as the effect of SCWE on fatigue properties. Size 6-inch cups produced with various draw ratios or trimmed at different heights were tested to determine the ductile-to-brittle-transition temperature (DBTT) as a function of strain. The 2-inch cup/expansion test, bend test and fracture of notched specimens were also used to generate information complementary to that provided by the 6-inch cup/expansion test. The relationship between laboratory tests and fracture in real parts was established by testing large-scale parts. The fatigue behavior was investigated in the as-rolled and deep drawn (high stain) conditions, using prestrained specimens taken from the wall of a formed part.

NTIS

Steels; Embrittlement; Cold Working

20030068241 Boeing Co., USA

Aging Optimization of Aluminum-Lithium Alloy L277 for Application to Cryotank Structures

Sova, B. J.; Sankaran, K. K.; Babel, H.; Farahmand, B.; Cho, A.; [2003]; 16 pp.; In English; AeroMat 2003, 9-12 Jun. 2003, Dayton, OH, USA; Copyright; Avail: CASI; A03, Hardcopy

Compared with aluminum alloys such as 2219, which is widely used in space vehicle for cryogenic tanks and unpressurized structures, aluminum-lithium alloys possess attractive combinations of lower density and higher modulus along with comparable mechanical properties and improved damage tolerance. These characteristics have resulted in the successful use of the aluminum-lithium alloy 2195 for the Space Shuttle External Tank, and the consideration of newer U.S. aluminum-lithium alloys such as L277 and C458 for future space vehicles. A design of experiments aging study was conducted for plate and a limited study on extrusions. To achieve the T8 temper, Alloy L277 is typically aged at 290 F for 40 hours. In the study for plate, a two-step aging treatment was developed through a design of experiments study and the one step aging used as a control. Based on the earlier NASA studies on 2195, the first step aging temperature was varied between 220 F and 260 F. The second step aging temperatures was varied between 290 F and 310 F, which is in the range of the single-step aging temperature. For extrusions, two, single-step, and one two-step aging condition were evaluated. The results of the design of experiments used for the T8 temper as well as a smaller set of experiments for the T6 temper for plate and the results for extrusions will be presented.

Derived from text

Aluminum-Lithium Alloys; Aging (Materials); Mechanical Properties; Cryogenics

20030068249 Jefferson (Thomas) Lab. Computer Center, Newport News, VA, USA, Virginia Univ., Charlottesville, VA, USA

Elasto-Plastic Behavior of High RRR Niobium: Effects of Crystallographic Texture, Microstructure and Hydrogen Concentration

Myeni, G. R.; Agnew, S. R.; 2002; 17 pp.; In English

Report No.(s): DE2003-807885; No Copyright; Avail: Department of Energy Information Bridge

Conventional assessments of the mechanical properties of polycrystalline high RRR niobium via tensile testing have revealed unusually low apparent Young's moduli and yield strength in annealed samples. These observations motivated the current investigation of a variety of possible contributors: crystallographic texture, grain size, and impurity concentrations. It is shown that the crystallographic textures of a single lot of niobium are essentially unchanged by post-recrystallization anneals at temperatures up to 800 degree centigrade. Ultrasonic measurements reveal that the elastic response is not degraded by annealing. Rather, the material's extremely low yield point gives the impression of a low elastic modulus during tensile testing.

NTIS

Crystals; Crystal Structure; Niobium; Microstructure

20030068251 NASA Glenn Research Center, Cleveland, OH, USA

The Effect of Heat Treatment on the Fatigue Behavior of Alloy 10

Gayda, John; Kantzos, Pete; Telesman, Jack; August 2003; 29 pp.; In English; Original contains black and white illustrations

Contract(s)/Grant(s): WU 708-24-13

Report No.(s): NASA/TM-2003-212473; E-14011; NAS 1.15:212473; Copyright; Avail: CASI; A03, Hardcopy

The results of the fatigue evaluation on Alloy 10, run under NASA's Ultrasafe Project, are the subject of this report. Crack growth evaluation will be examined in a separate report. The eight heat treatments studied were designed to evaluate the effect of solution temperature, cooling rate, and stabilization on key mechanical properties of Alloy 10, including fatigue life. Two temperatures were studied, 750 and 1300 F, which represent projected application temperatures for the bore and rim locations in a disk. In addition to fatigue life, the cyclic stress-strain response and failure modes of the fatigue specimens are also reviewed in this report.

Author

Fatigue Life; Tensile Properties; Nickel Alloys; Chromium Alloys; Cobalt Alloys; Aluminum Alloys; Titanium Alloys; Niobium Alloys; Tungsten Alloys; Molybdenum Alloys

20030068263 National Inst. of Standards and Technology, Gaithersburg, MD, USA, Jefferson (Thomas) Lab. Computer Center, Newport News, VA, USA

Determination of Hydrogen in Niobium by Cold Neutron Prompt Gamma-Ray Activation Analysis and Neutron Incoherent Scattering

Paul, R. L.; Chen-Mayer, H. H.; Myneni, G. R.; 2002; 15 pp.; In English

Report No.(s): DE2003-807886; No Copyright; Avail: Department of Energy Information Bridge

The presence of trace amounts of hydrogen in niobium is believed to have a detrimental effect on the mechanical and superconducting properties. Unfortunately, few techniques are capable of measuring hydrogen at these levels. We have developed two techniques for measuring hydrogen in materials. Cold neutron prompt gamma-ray activation analysis (PGAA) has proven useful for the determination of hydrogen and other elements in a wide variety of materials. Neutron incoherent scattering (NIS), a complementary tool to PGAA, has been used to measure trace hydrogen in titanium. Both techniques were used to study the effects of vacuum heating and chemical polishing on the hydrogen content of superconducting niobium.

NTIS

Niobium; Superconductors (Materials); Hydrogen; Impurities

20030068302 Technical Research Centre of Finland, Espoo, Finland

Modelling the Transport in the Porous Layer of Oxide Films Formed on Material Surfaces in Nuclear Power Plants. Model Extension to More General Conditions

Lehikoinen, J.; Olin, M.; Mar. 2002; 31 pp.; In English

Report No.(s): PB2003-104816; VTT/RN-2131; No Copyright; Avail: CASI; A03, Hardcopy

In this study, the role of the porous oxide film, deposited on top of the primary passive (compact) film to control activity incorporation on the primary circuit surfaces of nuclear power plants (NPPs) is investigated. To serve this purpose, a

computerized steady-state transport model, previously developed for a simplified BWR case, has been extended to take into consideration more general high-temperature aqueous and oxide compositions. In practical terms, computationally laborious multi-species reactions for ion, aqueous complexes, precipitates and dissolved gases as well as three types of boundary conditions at the compact film/porous film interface can now be included in the revised model. The model is rendered flexible enough to enable comparison of the effects of various NPP operating conditions, including those prevailing in PWRs. In this report, results calculated with the revised transport model for a BWR system are presented and discussed.
NTIS
Nuclear Power Plants; Oxide Films; Iron Oxides

20030068584 Nippon Electric Co. Ltd., Tsukuba, Japan
Catalysts to Control the Growth and Structure of Single-Wall Carbon Nanotubes
Yudasaka, Masako; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 4; In English; See also 20030068525; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

In previous reports, we compared the catalytic efficiencies of various metals in producing single wall nanotubes (SWNT) by arc discharge and Nd:YAG laser ablation, and discussed what causes the different catalytic activities. We suggested that the crystallographic orientation of catalysts might influence the growth of SWNTs and mentioned that it might also control the chirality of SWNTs. It is known that a metal film deposited on a surface with a defined crystallographic face takes a unique orientation. We also reported that Ni deposited on different faces of sapphires took different orientations and had different graphitization effects on carbon. These results suggest that SWNT growth on catalysts whose crystallographic orientation is controlled by a well defined surface would enable us to study how the catalysts influence the structures of SWNTs. In our first trial of this, we grew SWNTs on Fe-coated sapphire by chemical vapor deposition and found that the yield and diameter distribution depended on the crystallographic face of the sapphire. Further investigation indicated that strong Fe-sapphire interaction resulted in Fe-Al alloy formation, and the sapphire-surface damages were considerably increased by carbon. Degree of these structure changes depended on the crystallographic face and surface states of sapphires. It is likely that these structure changes also occur when another metals and substrate materials were used for SWNT growth. Studies on the carbon-metal-substrate interaction would enable to prepare the SWNT-growth catalysts suitable to grow SWNTs with well-defined structures.
Author
Carbon Nanotubes; Walls; Crystal Growth; Neodymium Lasers; Catalytic Activity

20030068597 Hong Kong Polytechnic, Hung Hum, Hong Kong
Interaction Between Catalyst Metals and Stone-Wales Defects in Carbon Nanotubes
Meng, F. Y.; Zhou, L. G.; Shi, San-Qiang; Yang, Rui; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 65-69; In English; See also 20030068525; Original contains color illustrations
Contract(s)/Grant(s): A-PE54; No Copyright; Avail: CASI; A01, Hardcopy

A Stone-Wales (SW) defect is a dipole of 5-7 ring pair in graphite networks. A SW defect has a strong effect on the mechanical properties of carbon nanotubes (CNTs), and is in fact one of most important defective structures in CNTs. Using first-principles methods, we calculated the interaction of SW defects with a series of foreign atoms that had been used as catalysts for the growth of CNTs, including Fe, Ni, Co, Ti, Cu, Al, Mg, and Mo. It was found that the adsorption of most of these foreign atoms at SW defects is energetically preferred when compared with a defect-free structure, and that transition metals generally have a strong attractive interaction with CNTs due to the unfilled 3d shells.
Author
Defects; Carbon Nanotubes; Transition Metals; Adsorption

20030068656 Nanyang Technological Univ., Nanyang, Singapore
Oxidation Effects on Polycrystalline Diamond Film Surface
Li, Jingqi; Zhang, Qing; Yoon, S. F.; Ahn, J.; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 275-278; In English; See also 20030068525; Original contains color and black and white illustrations; No Copyright; Avail: CASI; A01, Hardcopy

Polycrystalline diamond films deposited by Hot Filament CVD technique are oxidized in both Thermogravimetric Analyser (TGA) and Lindberg furnace at temperature from 500 C to 800 C. TGA result shows that the onset oxidation

temperature is about 7000C and the activation energy is 175kJ/mol. SEM images indicate that {111} facets are preferentially oxidized, {100} is the least reactive facets. On {111} facts, the oxidation is not randomly but regularly oriented, with some thin and long ridges parallel to <110> direction, which has not been reported before. After oxidation at 700 C and 800 C, slight graphitization on diamond surface is indicated by Raman spectra.
Author
Polycrystals; Oxidation; Diamond Films; Activation Energy; Flat Surfaces

20030068863 QSS Group, Inc., Cleveland, OH, USA
Protection of Advanced Copper Alloys With Lean Cu-Cr Coatings
Greenbauer-Seng, L., Technical Monitor; Thomas-Ogbuji, L.; August 2003; 14 pp.; In English; International Symposium on Corrosion Science in the 21st Century, 6-11 Jul. 2003, Manchester, UK
Contract(s)/Grant(s): NAS3-98008; WBS-22-721-26-06
Report No.(s): NASA/CR-2003-212548; E-14114; NAS 1.26:212548; No Copyright; Avail: CASI; A03, Hardcopy

Advanced copper alloys are used as liners of rocket thrusters and nozzle ramps to ensure dissipation of the high thermal load generated during launch, and Cr-lean coatings are preferred for the protection of these liners from the aggressive ambient environment. It is shown that adequate protection can be achieved with thin Cu-Cr coatings containing as little as 17 percent Cr.
Author
Copper Alloys; Chromium Alloys; Metal Coatings; Protective Coatings; Rocket Thrust

20030068866 QSS Group, Inc., Cleveland, OH, USA
Oxidation-Reduction Resistance of Advanced Copper Alloys
Greenbauer-Seng, L., Technical Monitor; Thomas-Ogbuji, L.; Humphrey, D. L.; Setlock, J. A.; August 2003; 13 pp.; In English; International Symposium on Corrosion Science in the 21st Century, 6-11 Jul. 2003, Manchester, UK
Contract(s)/Grant(s): NAS3-98008; WBS-22-721-26-06
Report No.(s): NASA/CR-2003-212549; E-14115; NAS 1.26:212549; No Copyright; Avail: CASI; A03, Hardcopy

Resistance to oxidation and blanching is a key issue for advanced copper alloys under development for NASA's next generation of reusable launch vehicles. Candidate alloys, including dispersion-strengthened Cu-Cr-Nb, solution-strengthened Cu-Ag-Zr, and ODS Cu-Al2O3, are being evaluated for oxidation resistance by static TGA exposures in low-p(O2) and cyclic oxidation in air, and by cyclic oxidation-reduction exposures (using air for oxidation and CO/CO2 or H2/Ar for reduction) to simulate expected service environments. The test protocol and results are presented.
Author
Copper Alloys; Oxidation-Reduction Reactions; Oxidation Resistance; Powder Metallurgy; Degradation

20030068928 Universal Energy Systems, Inc., Dayton, OH, USA
Gamma (K5 Based) Compressor Blade Material Design - Alpha Extrusion on a Small Scale
Kim, Young-Won; September 04, 2003; 29 pp.; In English
Contract(s)/Grant(s): NASA Order C-75255-T; UES Proj. 720; No Copyright; Avail: CASI; A03, Hardcopy

The objective of the 2003 study is to develop a mechanically processed, high temperature TiAl alloy for use in the Turbine Based Combined Cycle compressor. An aging study with 3 temperatures and 4 time periods at each temperature will be conducted to determine the optimum aging condition. High-magnification microscopic analyses shall be employed to define the size distribution of carbide as a function of aging temperature/time. The contractor shall define optimum materials' conditions by conducting tensile and creep testing for two over-aging conditions for both alloys and fatigue testing for one over-aging condition for each alloy.
Author
Titanium Alloys; Aluminum Alloys; Turbine Blades; Extruding; Aging (Metallurgy); Microstructure

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*.

20030067728 Luna Innovations, Inc., Blacksburg, VA, USA
Rotationally Molded Liquid Crystalline Polymers
Rogers, Martin; Scribben, Eric; Baird, Donald; Hulcher, Bruce; [2002]; 1 pp.; In English; International Conference on Composite Materials, 14-18 Jul. 2003, San Diego, CA, USA
Contract(s)/Grant(s): NAS8-02111; Copyright; Avail: Other Sources; Abstract Only

Rotational molding is a unique process for producing hollow plastic parts. Rotational molding offers low cost tooling and can produce very large parts with complicated shapes. Products made by rotational molding include water tanks with capacities up to 20,000 gallons, truck bed liners, playground equipment, air ducts, Nylon fuel tanks, pipes, toys, stretchers, kayaks, pallets, and many others. Thermotropic liquid crystalline polymers are an important class of engineering resins employed in a wide variety of applications. Thermotropic liquid crystalline polymers resins are composed of semirigid, nearly linear polymeric chains resulting in an ordered mesomorphic phase between the crystalline solid and the isotropic liquid. Ordering of the rigid rod-like polymers in the melt phase yields microfibrous, self-reinforcing polymer structures with outstanding mechanical and thermal properties. Rotational molding of liquid crystalline polymer resins results in high strength and high temperature hollow structures useful in a variety of applications. Various fillers and reinforcements can potentially be added to improve properties of the hollow structures. This paper focuses on the process and properties of rotationally molded liquid crystalline polymers. This paper will also highlight the interactions between academia and small businesses in developing new products and processes.
Author
Crystallinity; Mechanical Properties; Molding Materials; Polymers; Liquid Crystals

20030067739 Massachusetts Univ., Amherst, MA
Biomimetic Polymers with Antimicrobial Activity
Tew, Gregory N.; Arnt, Lachelle; Mar. 6, 2003; 6 pp.; In English
Contract(s)/Grant(s): DAAD19-02-1-0240
Report No.(s): AD-A414733; ARO-43790.1-CH-II; No Copyright; Avail: CASI; A02, Hardcopy

Structural proteinomics is providing rapid insight into the structural and biological functions of many proteins. Our intention was to use this understanding to develop polymers that are more stable and inexpensive to produce than natural proteins, but nevertheless mimic their important biological properties. Toward this goal, we have focused on the host defense peptides, which are a broad class of peptides with remarkable antimicrobial properties against a host of organisms including Gram- negative and Gram-positive bacteria. These peptides have a common physiochemical motif that leads to their biological activity, which is an overall cationic and amphiphilic architecture. We developed polymers that also have an overall cationic and amphiphilic architecture similar to the peptides. Recently, similar work has been reported on beta-amino acids however these materials are still very labor intensive and expensive to produce. Nonetheless, they demonstrate that non-natural polymers can be used to mimic peptide activity. We developed a family of very inexpensive polymers that mimic the structural characteristics of amphiphilic beta-sheet peptides.
DTIC
Polymers; Activity (Biology); Physiochemistry; Microorganisms

20030067755 California Univ., Santa Barbara, CA
Shape Forming via Colloidal Isopressing: Reformulating a Commerical Silicon Nitride Slurry with a Commercial Silane
Essmann, Hannes; Bock, Ryan; Pujari, V. K.; Lange, F. F.; May 2003; 14 pp.; In English
Contract(s)/Grant(s): DAAD19-02-1-0380
Report No.(s): AD-A414748; ARO-43773.1-MS; No Copyright; Avail: CASI; A03, Hardcopy

Colloidal Isopressing is a new shape forming method that requires a pre-consolidated slurry with a flow stress much less than that of a commercial throwing clay (< 0. 1 MPa), so that it can be injected into a rubber cavity and isopressed. It is shown that the desired interparticle pair potential can be achieved with a commercial silane for a commercial Si3N4 aqueous slurry (NT 154-X12) containing densification aids. Unlike previous work, this silane has a relatively short molecular length and unlike previous results, the addition of salt was not needed to shorten the molecule and achieve the rheological behavior after

pre-consolidation. The results of this study also show that the transition from a fluid-like to elastic-like behavior after consolidation was related to the relative density achieved during the pre-consolidation step, which was dependent on the consolidation pressure.
DTIC
Slurries; Shapes; Colloids

20030067771 Pennsylvania State Univ., University Park, PA
STIR - Synthesis and Characterization of Nanotube-Elastomer Damping Composites
Wang, K. W.; Bakis, Charles; Apr. 28, 2003; 7 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): DAAD19-02-1-0326
Report No.(s): AD-A414762; ARO-43858.1-EG-II; No Copyright; Avail: CASI; A02, Hardcopy

The objectives of this research are: (a) to develop novel polymeric damping composites through distributing carbon nanotubes (CNTs) within the host polymer, and (b) to investigate the damping characteristics of such new composites. We aim to obtain good understanding and insight of this innovative approach and provide guidelines for future research possibilities. In this study, the system is modeled using a four-phase composite, composed of a resin, voids, and bonded and debonded nanotubes. To address damping effects, the concept of interfacial 'stick-slip' frictional motion between the nanotubes and the resin is proposed. The analytical results show that the critical bonding stress, nanotube weight ratio and structure deformation are the factors affecting the damping characteristic. Experimental efforts are also performed to verify the trends predicted by the analysis. Through comparing with neat resin specimens, the study shows that one can indeed enhance damping by adding CNT fillers into polymeric resins. The test results also show that the damping ratio of specimens with nanotubes depends on the strain (deformation) of the composite, with trends similar to those predicted by the analytical model, showing the validity of the model and the analytical predictions.
DTIC
Polymers; Composite Materials; Prediction Analysis Techniques

20030068145 NASA Glenn Research Center, Cleveland, OH, USA
Predicting the Reliability of Ceramics Under Transient Loads and Temperatures With CARES/Life
Nemeth, Noel N.; Jadaan, Osama M.; Palfi, Tamas; Baker, Eric H.; July 2003; 27 pp.; In English; Symposium on Probabilistic Aspects of Life Prediction, 6-7 Nov. 2003, Miami, FL, USA; Original contains color illustrations
Contract(s)/Grant(s): WBS-22-708-31-09
Report No.(s): NASA/TM-2003-212498; NAS 1.15:212498; E-14039; No Copyright; Avail: CASI; A03, Hardcopy

A methodology is shown for predicting the time-dependent reliability of ceramic components against catastrophic rupture when subjected to transient thermomechanical loads (including cyclic loads). The methodology takes into account the changes in material response that can occur with temperature or time (i.e., changing fatigue and Weibull parameters with temperature or time). This capability has been added to the NASA CARES/Life (Ceramic Analysis and Reliability Evaluation of Structures/Life) code. The code has been modified to have the ability to interface with commercially available finite element analysis (FEA) codes executed for transient load histories. Examples are provided to demonstrate the features of the methodology as implemented in the CARES/Life program.
Author
Mechanical Properties; Ceramics

20030068247 NASA Glenn Research Center, Cleveland, OH, USA
Increased Surface Fatigue Lives of Spur Gears by Application of a Coating
Krantz, Timothy L.; Cooper, Clark V.; Townsend, Dennis P.; Hansen, Bruce D.; August 2003; 14 pp.; In English; 2003 International Design Engineering Technical Conferences and Computers and Information in Engineering Conference, 2-6 Sep. 2003, Chicago, IL, USA; Original contains color and black and white illustrations
Contract(s)/Grant(s): WBS 22-708-90-01; DA Proj. 1L1-62211-A--47-A
Report No.(s): NASA/TM-2003-212463; E-14001; NAS 1.15:212463; ARL-TR-2971; DETC2003-48114; Copyright; Avail: CASI; A03, Hardcopy

Hard coatings have potential for increasing gear surface fatigue lives. Experiments were conducted using gears both with and without a metal-containing, carbonbased coating. The gears were case-carburized AISI 9310 steel spur gears. Some gears were provided with the coating by magnetron sputtering. Lives were evaluated by accelerated life tests. For uncoated gears, all of fifteen tests resulted in fatigue failure before completing 275 million revolutions. For coated gears, eleven of the fourteen

tests were suspended with no fatigue failure after 275 million revolutions. The improved life owing to the coating, approximately a six-fold increase, was a statistically significant result.
Author
Gears; Fatigue (Materials); Coatings

20030068267 NASA Glenn Research Center, Cleveland, OH, USA
Durability of ITO-MgF2 Films for Space-Inflatable Polymer Structures
Kerslake, Thomas W.; Waters, Deborah L.; Schieman, David A.; Hambourger, Paul D.; July 2003; 13 pp.; In English; First International Energy Conversion Engineering Conference, 17-21 Aug. 2003, Portsmouth, VA, USA; Original contains color illustrations
Contract(s)/Grant(s): NCC3-740; NCC3-1023; NCC3-1033; WBS-22-757-01-12
Report No.(s): NASA/TM-2003-212512; E-14072; NAS 1.15:212512; AIAA Paper 2003-5919; No Copyright; Avail: CASI; A03, Hardcopy

This paper presents results from ITO-MgF2 film durability evaluations that included tape peel, fold, thermal cycle, and AO exposure testing. Polymer coupon preparation is described as well as ITO-MgF2 film deposition equipment, procedures and film characterization. Durability testing methods are also described. The pre- and post-test condition of the films is assessed visually, microscopically, and electrically. Results show that at ~500 ITO - 9 vol% MgF2 film is suitable to protect polymer surfaces, such as those used in space-inflatable structures of the PowerSphere microsatellite concept, during a 1-year Earth orbiting mission. Future plans for ground-based and orbital testing of this film are also discussed.
Author
Magnesium Fluorides; Durability; Protective Coatings

20030068296 NASA Glenn Research Center, Cleveland, OH, USA
Toward an Improved Hypersonic Engine Seal
Dunlap, Patrick H., Jr.; Steinetz, Bruce M.; DeMange,Jeffrey J.; Taylor, Shawn C.; July 2003; 24 pp.; In English; 39th AIAA/ASME/SAE/ASEE Joint Propulsion Conference and Exhibit, 20-23 Jul. 2003, Huntsville, AL, USA; Original contains color and black and white illustrations
Contract(s)/Grant(s): WBS 22-713-82-31
Report No.(s): NASA/TM-2003-212531; E-14093; NAS 1.15:212531; AIAA Paper 2003-4834; No Copyright; Avail: CASI; A03, Hardcopy

High temperature, dynamic seals are required in advanced engines to seal the perimeters of movable engine ramps for efficient, safe operation in high heat flux environments at temperatures from 2000 to 2500 F. Current seal designs do not meet the demanding requirements for future engines, so NASA s Glenn Research Center (GRC) is developing advanced seals to overcome these shortfalls. Two seal designs and two types of seal preloading devices were evaluated in a series of compression tests at room temperature and 2000 F and flow tests at room temperature. Both seals lost resiliency with repeated load cycling at room temperature and 2000 F, but seals with braided cores were significantly more flexible than those with cores composed of uniaxial ceramic fibers. Flow rates for the seals with cores of uniaxial fibers were lower than those for the seals with braided cores. Canted coil springs and silicon nitride compression springs showed promise conceptually as potential seal preloading devices to help maintain seal resiliency.
Author
Sealing; Hypersonic Vehicles

20030068335 National Inst. for Occupational Safety and Health, Cincinnati, OH, USA
Recommendations for the Study of Control Measures for Overspray Generated During Bed Liner Application
Heitbrink, W. A.; Almaguer, D.; Apr. 2003; 16 pp.
Report No.(s): PB2003-106597; EPHB-294-05A; No Copyright; Avail: CASI; A03, Hardcopy

Walk-through surveys were conducted at the training facilities of two distributors of diisocyanate based elastomeric truck bed-liner products, and two shops that apply spray-on truck bed-liners. The spray-on bed-liner process involves the application of a protective coating to the bed of pick-up trucks or other surfaces. The objective of these walk-through surveys was to learn about the process and to develop recommendations for the development of measures to control polymeric diisocyanate exposures in the spray-on bed-liner industry. The bed-liner is applied as a two part resin. Part A is a polymeric diisocyanate with varying percentages of diphenylmethane diisocyanate (MDI) isomers, MDI oligomers, and polymeric MDI. Part B is a polyol that reacts with the polymeric diisocyanate to form a tough, resilient elastomeric surface coating. The report describes

the spray-on bed-liner process, proposes future studies, recommends control strategies, and presents an engineering control design concept.
NTIS
Protective Coatings; Sprayed Coatings; Control

20030068525 NASA Glenn Research Center, Cleveland, OH, USA
Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference (ADC/FCT 2003)
Murakawa, M., Editor; Miyoshi, K., Editor; Koga, Y., Editor; Schaefer, L., Editor; Tzeng, Y., Editor; August 2003; 642 pp.; In English; Seventh Applied Diamond Conference, 18-21 Aug. 2003, Tsukuba, Japan; See also 20030068526 - 20030068702
Contract(s)/Grant(s): WBS 22-708-31-14
Report No.(s): NASA/CP-2003-212319; NAS 1.55:212319; E-13906; No Copyright; Avail: CASI; A99, Hardcopy

These are the Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference held at Epochal Tsukuba International Conference Center from August 18 to 21, 2003. The diamond CVD process was first reported by Dr. Spitsyn in 1981 and Prof. S. Iijima reported his discovery of carbon nanotubes in 1991. In the past years, both diamond-related materials and novel carbon materials have attracted considerable interest by the scientific, technological, and industrial community. Many practical and commercial products of diamond materials are reported in these proceedings. A broad variety of applications of carbon nanotubes and novel carbons have also been explored and demonstrated. Having more than 175 invited and contributing papers by authors from over 18 countries for presentations at ADC/FCT 2003 clearly demonstrates that these materials, due to the combination of their superior properties, are both scientifically amazing and economically significant.
Author
Carbon Nanotubes; Conferences; Vapor Deposition; Diamond Films; Diamonds; Catalytic Activity; Nanostructure Growth; Nanotechnology

20030068526 Michigan State Univ., East Lansing, MI, USA
Designing Carbon-Based Nanotechnology on a Supercomputer
Tomanek, David; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 10; In English; See also 20030068525; Original contains color illustrations
Contract(s)/Grant(s): NSF DMR-01-03587; No Copyright; Avail: CASI; A01, Hardcopy

The continuous reduction of device sizes, which is rapidly approaching the atomic level, calls for new approaches to design and test future building blocks of Nanotechnology. Supercomputers are rapidly becoming the most powerful tool to interpret what happens on the nanometer scale. In nanotubes, the large phonon mean-free path, a consequence of atomic-scale perfection and quasi one-dimensional structure, leads to an extremely high thermal conductivity. In nanostructures that form during a hierarchical self-assembly process, even defects may play a different, often helpful role. Utilizing defect engineering, scrolls may be efficiently transformed to multi-wall nanotubes, and adjacent nanotubes may fuse to form Y-junctions. Fullerenes may enter nanotubes to form peapods and, once encapsulated, fuse to nanocapsules. The presentation will show, some of these challenging problems can be most efficiently addressed in simulations on recently available massively parallel supercomputer
Author
Nanotechnology; Nanostructures (Devices); Carbon Nanotubes

20030068527 Japan Fine Ceramics Center, Higashi, Japan
Synthesis Of Nanographite-Ribbon
Kyotani, Mutsumasa; Yamaguchi, Chiharu; Matsui, Hisaji; Koga, Yoshinori; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 42-44; In English; See also 20030068525; Original contains black and white illustrations; No Copyright; Avail: CASI; A01, Hardcopy

Graphitic materials in nanometer size (nanographite) having edges of carbon hexagonal bond network is in very recent years attracting much attention because the theoretical approach has shown that such a nanographite is able to have a special electronic state at the edges, especially the zigzag ones. We have succeeded in synthesizing the nanographite by means of electrochemical reduction following electron beam irradiation for per-fluoro-aromatic pitch and by means of thermal decomposition of hydrocarbon polymers. The structural properties of graphitic materials were investigated using x-ray photo-electron spectroscopy, Raman scattering spectroscopy, x-ray diffraction measurements and electron microscopy. In this

work, ribbon-shaped nanographite (nanographite-ribbon) in a thickness of below 10 nm having the edges was obtained. The structure of the nanographite-ribbon will be discussed.
Author
Nanofabrication; Nanocrystals; Graphite

20030068533 Agency of Industrial Science and Technology, Tsukuba, Japan
Deposition of BC/ta-C Multilayer Thin Films by Laser Ablation
Taniwaki, Manabu; Suzuki, Masahiro; Ishihara, Masatou; Koga, Yoshinori; Kokai, Fumio; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 352; In English; See also 20030068525; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

We deposited amorphous multilayer thin films of boron carbide (BC) and tetrahedral amorphous carbon (ta-C) by pulsed laser deposition (PLD) using B4C and graphite targets at room temperature. The laser beam (266 nm, 4-5 ns pulse width) from a Q-switchd Nd:YAG laser was used to irradiate the targets at a constant laser fluence of 4 J/cm2. The multilayer films consisted of bilayer structures with a bilayer period in the nanometric range (1-128 nm). The hardness of BC/ta-C multilayer thin films measured by a nanoindentation technique were between 38 and 48 GPa, dependent on the thickness of the layer. The highest hardness value was obtained for = 8 nm. The coefficient of friction was in the range 0.1-0.27, which is lower than that of BC single-layer films (>1.0). We also deposited amorphous multilayer thin films of boron nitride (BN) and ta-C to compare with BC/ta-C multilayer thin films.
Author
Boron Carbides; Carbon; Hardness

20030068539 National Inst. for Materials Science, Tsukuba, Japan
A Novel Catalytic Synthesis Of Carbon Nanotubes In Alcohol Liquid
Nakagawa, Kiyoharu; Ando, Toshihiro; Nishitani-Gamo, Mikka; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 5-9; In English; See also 20030068525; Original contains black and white illustrations
Contract(s)/Grant(s): JST-14350429; No Copyright; Avail: CASI; A01, Hardcopy

Well-aligned carbon nanotubes arrays were grown on silicon substrates by using a novel catalytic method in organic liquid such as alcohols. Un-equilibrium catalytic deposition gave significantly pure carbon nanotubes with very little soot within a few minutes in methanol. Scanning electron microscope images indicate that the nanotubes arrays are grown perpendicular to the silicon substrate surface with a significantly high density like a flower arrangement frog. This very fast and dense production of carbon nanotubes can be attributed to the great difference of chemical potential between the substrate surface and reactant liquid.
Author
Carbon Nanotubes; Nanostructure Growth; Catalytic Activity; Organic Liquids

20030068540 City Univ. of Hong Kong, Hong Kong
Sonochemical Synthesis of Carbon Nanotubes and Nanoonions Under Ambient Conditions Using a SINW Template
Li, C. P.; Sun, X. H.; Wong, N. B.; Lee, C. S.; Teo, B. K.; Lee, S. T.; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 41; In English; See also 20030068525; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

Under ambient conditions, room-temperature and atmospheric-pressure, carbon nanotubes (CNTs) and carbon nanoonions (CNOs) were synthesized by reacting silicon nanowires (SiNWs) with organic solvents in a laboratory sonicator. As many common organic solvents are applicable and SiNWs can be produced plentifully from the oxide-assisted growth process, this simple method using the mildest growth conditions provides a convenient, inexpensive synthesis of large quantities of CNTs and CNOs. We believe both the local high temperature caused by sonication and the reductive power of the hydrogen-passivated SiNW (oxide-coated SiNW did not work) contribute to the conversion of the organic solvent molecules to graphite sheets which wrap around the SiNWs or Si nanoparticles (SiNP) to form CNTs or CNOs, respectively. With proper tuning (e.g. solvent type and temperature, ultrasonic power, etc), the sonochemical process can be adapted for mass production of either CNTs or CNOs.
Author
Carbon Nanotubes; Nanostructure Growth; Ultrasonic Processing

20030068541 Academy of Sciences of the Ukraine, Kiev, Ukraine

About The Influence of Bioaktivite Carbon Materials Nanoclusters Structures on Effectivity of Ecosystem Sorption-Catalytic Purifying from Oil Products

Dmitriy, Shvets; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 45; In English; See also 20030068525; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

No abstract available

CASI

Oils; Nanostructure (Characteristics); Carbonaceous Materials

20030068551 Tohoku Univ., Sendai, Japan

Formation of Flat Polycrystalline Diamond Surface by Ion Beam Etching

Yamada, Takatoshi; Sawabe, Atsuhito; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 218-221; In English; See also 20030068525; Original contains black and white illustrations; No Copyright; Avail: CASI; A01, Hardcopy

CVD polycrystalline diamond thin film was etched by Ar ion beam in order to form flat diamond surface. Beam incident angle and etching time were used as parameters. The etched surface was characterized by SEM and by 3-D morphological measurement system. It was found although the etching time of 50h was needed, the relatively flat surface was obtained.

Author

Diamond Films; Polycrystals; Vapor Deposition; Etching; Flat Surfaces; Argon

20030068554 National Inst. of Advanced Industrial Science and Technology, Tohoku, Japan

Chemical Modification of Diamond Powder Using Photolysis of Perfluoroazooctane

Nakamura, T.; Ishihara, M.; Ohana, T.; Koga, Y.; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 271-274; In English; See also 20030068525; No Copyright; Avail: CASI; A01, Hardcopy

Photolysis of perfluoroazooctane with diamond powders led to the chemical modification of the diamond surfaces under mild conditions to introduce perfluorooctyl ester and ether functional groups, confirming by means of FT-IR, XPS and 19F NMR measurements.

Author

Diamonds; Powder (Particles); Photolysis

20030068557 Teer Coatings Ltd., Hartlebury, UK

Tribological Properties of Graphite Like and Diamond Like Carbon Coatings

Teer, D. G.; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 323; In English; See also 20030068525; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

Two carbon based coatings with exceptional tribological properties have been developed. One is a Graphite like Carbon known as Graphit-iC (trademark), the other is a hydrogenated Diamond like Carbon known as Dymon-iC (trademark). There are some important differences between the two coatings. The Graphit-iC has excellent properties under water with wear rates better than 10-19m3/Nm but it has poor properties in vacuum. This is consistent with its graphite like properties. Dymon-iC has poor properties under water and early tests indicate that the properties in vacuum are good but more tests are needed. Both coatings have excellent tribological properties with oil under boundary lubrication conditions. In long term testing comparing Graphit-iC and Dymon-iC with a hard CrN coating no wear could be detected for any of the coatings but the bearing steel counterface had significant wear against the CrN coating with little wear against the carbon coatings. The mechanism of low friction for the Graphit-iC. has been studied in some detail and the results will be presented and discussed. The differences between the coatings lead to different types of application and some of these are presented.

Author (revised)

Graphite; Carbon; Tribology; Diamond Films

20030068558 National Inst. for Materials Science, Tsukuba, Japan

Intrinsic Absorption-Edge Spectrum and Indirect Exciton Related Luminescence of Cubic Boron Nitride

Watanabe, Kenji; Taniguchi, Takashi; Sakaguchi, Isao; Kanda, Hisao; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 331-333; In English; See also 20030068525; No Copyright; Avail: CASI; A01, Hardcopy

The indirest band gap nature of cubic Boron Nitride by means of absorption and cathodoluminescence spectroscopy is described. Samples were prepared by the temperature gradient method under high pressure and hig temperature conditions. A barium-BN catalyst was utilized. Samples showed a series of bands which is readily assigned to the indirect bound and free exciton luminescence assisted by zone-boundary phonons of point X. In addition, the absorption bands to represent the indirect exciton and band absorption nature is also observed being the indirect exciton energy being the respective phonon energies apart.
Author (revised)
Boron Nitrides; Luminescence; Absorption Spectra; Cathodoluminescence

20030068559 State Engineering Univ. of Armenia, Yerevan, Armenia
DLC Film Growth on the Surface of Monocrystalline Si and Alpha-Al2O3 With The Usage of Ion Source
Panosyan, Z.; Voskanyan, S.; Yengibaryan, Y.; Stepanyan, A.; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 334-339; In English; See also 20030068525; Original contains black and white illustrations; No Copyright; Avail: CASI; A02, Hardcopy

The technology of diamond-like carbon (DLC) film deposition, that allows to vary the composition and structure of the film giving an opportunity to modify the properties of the obtained samples, has been developed. In the present work the special gas-mixer was utilized, with the help of which the gas mixtures of C7H8 or C6H12, Ar and N2 were supplied between the anode and cathode of the ion source. By varying the electrical parameters of ion source and concentration of gas mixture and by shaping the plasma geometry, it is possible to modify the average kinetic energy of ions that have reached the substrate. This feature has permitted to grow DLC films on the surfaces of monocrystalline Si (c-Si), Al2O3 and other substrates over a 100 cm2 area with non-uniformity of characteristics less than 5%. The density of the obtained films has been increased up to 2.5 g/cm3, and the microhardness HV - up to 3100 kgf/mm2. The DLC films are stable to chemically hostile environment, to radiation impacts, as well to thermal influences up to 400 0C. By altering the film deposition conditions it is possible to vary the electrical, optical and mechanical properties of DLC films in a wide range.
Author
Carbon; Diamond Films; Mechanical Properties; Electrical Properties

20030068560 Japan Fine Ceramics Center, Higashi, Japan
Synthesis of B-C-N Films by Electron Beam Excited Plasma-Assisted rf Magnetron Sputtering
Hasegawa, Takeshi; Yamamoto, Kazuhiro; Kakudate, Yozo; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 366; In English; See also 20030068525; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

Boron-carbon-nitrogen (B-C-N) thin films have been synthesized using electron beam excited plasma (EBEP)-assisted rf magnetron sputtering system with boron nitride and graphite target. Compositions of the films were varied by controlling the rf power for the graphite target and determined by X-ray photoelectron spectroscopy. We obtained B(x)C(y)N films, x=1.0 - 1.1 and y = 0.03 - 0.25. The composition dependence of infrared transmission spectra showed that structure of the film was very sensitive to carbon content; a cubic phase was found only in a carbon-poor region and disappeared abruptly with increasing carbon content. Results of transmission electron microscope, electron diffraction, and electron energy loss spectroscopy measurements show that the films involve the cubic phase of carbon-poor B-C-N compound.
Author
Synthesis (Chemistry); Boron Nitrides; Carbon; Thin Films; Electron Beams; Plasmas (Physics); Radio Frequencies; Magnetron Sputtering

20030068561 Hong Kong Univ., Hong Kong
A Nanoindentation Study of Thick Cubic Boron Nitride Films Prepared by Chemical Vapor Deposition
Chan, C. Y.; Zhang, W. J.; Chan, K. M.; Bello, I.; Lee, S. T.; Matsumoto, S.; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 379; In English; See also 20030068525; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

The mechanical properties of high-quality cubic boron nitride (cBN) films deposited using fluorine chemistry were systematically investigated by nano-indentation measurements performed in both cross-sectional and plan-view directions. The large film thickness (~5 m) allows the effective suppression of both substrate and indenter size effects. The hardness and elastic modulus values were found to be 70 and 800 GPa, respectively, which are the highest values ever obtained on cBN films deposited by either PVD or CVD methods so far (comparable to those reported for cBN crystals synthesized by

high-pressure high-temperature methods). The variation of hardness across the cBN film thickness was investigated using a cross sectional configuration. In conjunction with the transmission electron microscopic observations, the relationship of the hardness measured with the crystallinity and crystal size/grain boundaries was discussed.
Author
Boron Nitrides; Nanoindentation

20030068567 China Scientific and Technical Univ., Hofei, China
Study of High Transparency Diamond Like Carbon Film on Quartz Substrate Growth by Hot-Filament Chemical Vapor Deposition
Niu, Xiao-Bin; Liao, Yuan; Shi, Hua-Liang; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 506; In English; See also 20030068525; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

By using the mixed methane and hydrogen gas, we successfully synthesized Diamond Like Carbon (DLC) films on quartz substrate in Hot-Filament Chemical Vapor Deposition (HFCVD) system. The prepared films were proved to be the DLC films by investigating the Raman Spectroscopy and have both very high hardness and high transparency (>80%) from 400nm to the whole infrared band, which can be used as shields of optical windows. We also did a series of experiments to study relations between the growth of the film and the Substrate temperature, Flament temperature, the time of growth and the consistency of methane and hydrogen.
Author
Carbon; Hardness; Crystal Growth

20030068568 Korean Inst. of Science and Technology, Seoul, Korea, Republic of
Nano Ni Dot Effect on the Structure of Tetrahedral Amorphous Carbon Films
Lee, Churl Seung; Kim, Tae-Young; Lee, Kwang Ryeol; Yoon, Ki Hyun; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 507-510; In English; See also 20030068525; Original contains black and white illustrations; No Copyright; Avail: CASI; A01, Hardcopy

Nano-scale manipulation of thin film structure has attracted much attention, owing to their possibilities to obtain novel properties associated with the nano-scale microstructure. A great effort is also focusing on the nano-scale manipulation of tetrahedral amorphous carbon (ta-C) films. Multilayer structures composed of ta-C films of different properties are the most widely investigated structure. In the present work, we demonstrated that nano-sized graphitic columns embedded in hard amorphous ta-C matrix could be prepared by using nano-sized Ni dots on the substrate surface. The Ni dots were prepared by annealing Ni thin film of thickness ranging from 3 to 13 nm. The ta-C film was then deposited by filtered vacuum arc process. Microstructure analysis and electrical resistivity measurement showed that nano-scale columns of highly conducting graphitic phase grew at the Ni dots. Size of Ni dot has significant effects on the nano-scale structure evolution, and thus mechanical and electrical properties. The growth of the graphitic phase was discussed in terms of the catalyst effect of Ni for the transformation of carbon materials into stable graphitic phase.
Author
Carbon; Nickel; Microstructure

20030068574 Himeji Inst. of Tech., Japan
Controlled Synthesis of Carbon Nanotubes by Arc in Water with Reduced Pressure
Sano, Noriaki; Naito, Masakazu; Iimura, Kenji; Matsuda, Satoshi; Kanki, Tatsuo; Kikuchi, Takeyuki; Chhowalla, Manish; Wang, Hao-Lan; Amaratunga, A. J.; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 26-30; In English; See also 20030068525; Original contains black and white illustrations; No Copyright; Avail: CASI; A01, Hardcopy

Synthesis of multi-walled carbon nanotubes (MWCNT) by an arc discharge between two graphite electrodes submerged in water under controlled pressure (from 400 760Torr) is reported. Transmission and scanning electron microscopy investigations of the arc discharge product collected from the bottom of the reactor revealed high concentrations of MWCNTs at all pressures. Dynamic light scattering (DLS) on suspensions containing MWCNTs showed that the mean diameter of the nanotubes increases with decreasing pressure. Raman Spectroscopy analysis reveals that the relative amount of disordered carbon is significantly less in the low pressure samples. Furthermore, the yield of the deposit was found to be independent of

the pressure. These results suggest that the physical properties of MWCNTs formed by the submerged arc can be controlled by varying the pressure.
Author
Carbon Nanotubes; Nanostructure Growth; Electrodes; Arc Discharges

20030068581 Auburn Univ., AL, USA
Hydration Properties of Carbon Nanotubes and Their Effects on Electrical and Bio-Sensor Applications
Tzeng, Y.; Huang, T. S.; Chen, Y. C.; Liu, Y. K.; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 12-16; In English; See also 20030068525; Original contains color and black and white illustrations; No Copyright; Avail: CASI; A01, Hardcopy

As-grown carbon nanotubes are hydrophobic, i.e., more attractive to non-polar groups than polar substances. Surfaces of hydrophobic carbon nanotubes have been treated by means of electrochemical, thermal, and plasma oxidation processes to convert them to hydrophilic surfaces. Effects of hydration properties of carbon nanotubes on electron field emission characteristics and interactions of carbon nanotubes with polar and non-polar molecules were explored. This paper summarizes our work in this area of research and presents results on the modification of the hydration properties of carbon nanotubes and their applications.
Author
Carbon Nanotubes; Nanostructure Growth; Hydrophobicity

20030068583 Nippon Electric Co. Ltd., Tsukuba, Japan
Ultra-Fast Dynamics In Electronically Excited Nanotubes: Time-Dependent Density Functional Approach
Miyamoto, Yoshiyuki; Rubio, Angel; Tomanek, David; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 11; In English; See also 20030068525; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

Because of extreme mechanical and electronic performance, carbon nanotube is promising material for application in nanotechnology. Currently formed nanotubes contain structural defects and impurities, which may cause degradation of nanotubes. Therefore, influence of defects and impurities on mechanical and electronic properties of nanotube should intensively be investigated. Furthermore, defect control will be an important technology in future nanotube applications. In this talk, we provide our recent first principles simulations on ultra fast dynamics in nanotubes triggered by electronic excitation. We first demonstrate that electronic excitation is useful to repair defected nanotube being subjected to heat treatment. Second, we show optical excitation can be a useful tool to detect particular kind of defects in nanotube, i.e. Stone-Wales type defects. We have performed molecular dynamics (MD) simulations based on of local density approximation (LDA) of the density functional theory (DFT) with use of plane-wave basis set and pseudopotentials. We adopted time-dependent LDA in order to perform MD simulation under electronic-excitation, where the time-dependent Kohn-Sham equation is solved to monitor time-evolution of electron wave functions. The details of this method are shown by Sugino and Miyamoto.
Author
Carbon Nanotubes; Nanotechnology; Nanostructure (Characteristics)

20030068587 Centre National de la Recherche Scientifique, Strasbourg, France
GISAXS Study of the Alignment of Oriented Carbon Nanotubes Grown on Plain SiO2/Si(100) Substrates by a Catalytically Enhanced CVD Process
Normand, F.; Cojocaru, C. S.; ManeMane; Jean, O.; Metzger, T. H.; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 25; In English; See also 20030068525; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

Despite the importance in the alignment of carbon nanotubes films to provide quite accurate emission centers for field emission, there are to our knowledge no quantitative study of the degree of alignment of CNTs films in the literature. Indeed SEM images provide a valuable qualitative impression of alignment in many reports but i) the images are only qualitative; ii) this is a local probe that can induce some misinterpretation about the true uniformity of the sample. Grazing Incidence Small Angle X-Ray Scattering (GISAXS) is well suited to get important structural information on the alignment and the correlation between nanostructures. In addition, we also investigate the alignment of CNTs by angular measurements of Auger electrons (C KVV transitions sensitive to the p electrons). In both cases the strong 1D anisotropic character of p electrons in oriented CNTs is spectroscopically probed. We have performed GISAXS experiments to get structural (orientation of the

alignment mainly, but also size distribution and density) and correlation information (mutual alignment, presence of defects in the orientation) on nanostructures grown on plain SiO2 (thickness 2-8 nm)/Si(100) substrates after dispersion of a metallic catalytic islands. It is expected to get a sharp GISAXS signal if the nanotubes are perfectly aligned normal to the surface. The degree of the alignment of CNTs was studied according to growth parameters (substrate temperature, NH3 concentration, gas activation parameters, nature of the metal).
Author
Carbon Nanotubes; Vapor Deposition

20030068588 Cambridge Univ., Cambridge, UK
Large-Scale Synthesis of Single-Walled Carbon Nanohorns Using the Arc in Liquid Method
Wang, Hao-Lan; Amaratunga, G. A. J.; Jia, S.; Sano, N.; Chhowalla, M.; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 31; In English; See also 20030068525; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

A novel and cost effective method has been developed for large-scale synthesis of single-walled nanohorns (SWNHs). This is the first report of an alternative method to laser ablation for formation of carbon nanohorns. The method is based on igniting an arc discharge between two graphite electrodes submerged in liquid nitrogen. Production rates of up to 17g/hr have been achieved. SEM analysis shows the nanohorns to be aggregated as nanoparticles with sizes in the range of 20~80nm. HRTEM reveals the internal structure of individual nanoparticle is an aggregation of either dahlia-like or bud-like single-walled nanohorns (SWNHs). It was further found that both the yield and morphology of nanohorns changed as a function of arc current density in liquid nitrogen. The yield of nanohorns increases with the increment of current density. Samples produced by higher current density contains more dahlia-like nanohorns than bud-like compared to those produced at lower current. The carbon arc in liquid nitrogen method holds the potential for controlling the structure of nanohorns as well as for allowing their production in large scale quantities required for applications such a fuel cell electrodes.
Author
Arc Discharges; Nanostructure Growth; Synthesis (Chemistry); Nanoparticles

20030068589 Shinshu Univ., Nagano, Japan
The Large-Scale Production of Nanofibers, MWNTS, SWNTS and Their Practical Applications
Endo, M.; Hayashi, T.; Kim, Y. A.; Yanagisawa, T.; Dresselhaus, M. S.; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 19-24; In English; See also 20030068525; Original contains color and black and white illustrations; No Copyright; Avail: CASI; A02, Hardcopy

The sp2-based fibrous carbons, such as carbon nanofibers, multi-wall carbon nanotubes and single-wall carbon nanotubes, have acted as a vanguard among nanomaterials with a high potential of applications in various fields of nano-technology, due to their extraordinary chemical and physical properties. One obstacle to recent trends toward widespread practical applications of fibrous carbon is considered to be the difficulty of large-scale production of high purity the fibrous carbons at a reasonable cost. In this sense, the catalytic chemical vapor deposition method (or pyrolysis of hydrocarbons) is considered to be the answer for the large-scale production of these fibrous carbons, especially, using a floating reactant method. Through exact control of synthetic conditions, it is possible to tailor the diameter, crystallinity, and the angle of truncated cones with regard to tube axis. In this study, we will report the synthetic method of fibrous carbons including SWNTs, especially the floating reactant method, describe structural characterizations for various fibrous carbons, and finally deal with practical applications for these fibrous carbons such as the filler in advanced nano-composite, electrochemical applications, field emitter etc.
Author
Carbon Nanotubes; Vapor Deposition; Nanostructure Growth; Fiber Composites

20030068590 Saarland Univ., Saarbruecken, Germany
Formation of Carbon Nanotubes by Catalysis of Transition Metals Obtained from Molecular Precursors
Sachdev, Hermann; Tince, Dominik; Knorr, Michael; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 32; In English; See also 20030068525; Original contains black and white illustrations; No Copyright; Avail: CASI; A01, Hardcopy

There is considerable interest to achieve a selective growth of carbon nanotubes from distinct nucleation centers on specific substrates, since they display a huge range for new applications. Transition metals can act as catalysts for the formation of carbon nanotubes. For this reasons, the influence of catalytically active metals supplied in an nanodisperse form regarding the formation of nanostructured carbon from the gas phase was studied. By this novel method, catalytically active

transition metal complexes were used to generate nucleation centers on silicon substrates for the formation of carbon nanotubes. A CVD route using methane was used to supply activated carbon species from the gas phase. Since the transition metals used for this investigation are catalyzing dehydrogenation reactions, the effects of the presence of those metals on the morphology of the deposits were studied in correlation with the process parameters (pressure, substrate temperature, precursor concentration). The deposits were characterized with SEM, infrared- and raman spectroscopy.
Author
Carbon Nanotubes; Nanostructure Growth; Deposits

20030068591 Centre National de la Recherche Scientifique, Strasbourg, France
Carbon Nanotubes Array Grown on Substrates Patterned by Combined Lithographic Techniques
LeNormand, F.; Cojocaru; Boukhari; Lezec; Ebbesen; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 33; In English; See also 20030068525; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

Field emission is one of the most promising potential applications of carbon nanotubes (CNTs). These nanostructures combine positively a geometrical effect (local exhaltation of the electric field due to a strong curvature radius) and an electronic effect (weak work function) as well as they display strong chemical inertness and thermal conductivity, which open the way to the realization of convenient electrons sources for vacuum electronics such as flat panels and cold cathodes. Field emission measurements obtained on CNTs grown on SiO2/Si(100) substrates by the DC HF CCVD process where a dispersion of metallic catalytic transition metal (Co, Ni) particles was previously performed, showed that the thresholds of emission were strongly dependent on the nature of the material. Therefore they were within the range 1-4 V/ m for CNTs. By contrast they ranged above 10V/mm either for carbon nanofibers or nanocones. However, the current densities were quire variable and often reached a rapid saturation both due to screening of the field by the high density of CNTs and to conductivity limitations of the substrate. Therefore, we used patterned surfaces to grow array of CNTs emitters. Patterned surfaces were obtained by controlled deposition of metallic spots by a combination of lithographics techniques, using either photons, electrons or ion beams. Array of particle islands of Co or Ni were obtained in the range 5-100 nm. Under proper CVD conditions we could grow subsequently one CNT by metallic island if the size of the metallic island did not exceed 60 nm.
Author
Carbon Nanotubes; Lithography; Emitters

20030068592 City Univ. of Hong Kong, Hong Kong
Well-Aligned Carbon Nanotubes From Methane/Nitrogen Plasma
Wong, W. K.; Lee, C. S.; Lee, S. T.; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 40; In English; See also 20030068525; Original contains black and white illustrations; No Copyright; Avail: CASI; A01, Hardcopy

Well-aligned carbon nanotubes (CNTs) were grown by microwave plasma-enhanced chemical vapor deposition using N2 as the carrier gases and CH4 as the carbon source. Iron films with different thicknesses on silicon substrates acted as catalysts. The growth and field emission properties of the CNTs were studied as functions of the iron catalyst film thickness and the CH4:N2 ratio. Scanning Electron Microscopy (SEM) and Atomic Force Microscopy (AFM) were used to study morphologies of the CNT films and the relationship between the iron film thickness and size of the iron clusters formed after the plasma treatment.
Author
Carbon Nanotubes; Vapor Deposition; Nanostructure Growth

20030068593 National Inst. for Materials Science, Tsukuba, Japan
Kinetics of Carbon Nanotube Forest Growth by Chemical Vapor Deposition
Louchev, O. A.; Laude, T.; Sato, Y.; Kanda, H.; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 46-51; In English; See also 20030068525; No Copyright; Avail: CASI; A02, Hardcopy

A theoretical study of carbon nanotube (NT) forest growth by chemical vapor deposition is given, including (i) ballistic mode of C species impingement into the NT surface, (ii) C diffusion over NT surface and through the metal nanoparticle and (iii) the temperature drop at the NT tip occurring with increase in NT length. The presence of a metal nanoparticle is shown to shift NT growth from being surface diffusion controlled to being controlled by bulk diffusion through the nanoparticle. For typical growth conditions the growth rate is shown to be controlled simultaneously by surface diffusion over NT surface and

bulk diffusion of C through metal nanoparticle. Even in specific cases where NT growth rate is controlled by bulk diffusion through the nanoparticle the initial stage may be controlled by surface diffusion, as revealed by the exponential change in NT length with time. A parametric study of the growth rate of NT forest with metal nanoparticles held at the NT tips as a function of temperature reveals the existence of a maximum near 1050-1100 K, agreeing with reported experiments. A thermal analysis based upon the heat conductance equation shows that with NT forest growth the temperature of the NT tips decreases, leading to growth deceleration and termination, suggesting that the larger the pressure the smaller the forest height that may be grown. Author

Carbon Nanotubes; Nanostructure Growth; Vapor Deposition

20030068601 Academy of Sciences of the Ukraine, Kiev, Ukraine

X-Ray Three-Beam Diffraction by Diamond Single Crystals

Tkach, V. N.; Fodchuk, I. M.; Borcha, M. D.; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 315-319; In English; See also 20030068525; Original contains black and white illustrations; No Copyright; Avail: CASI; A01, Hardcopy

We have studied the effect of the real structure of diamond single crystals on variations of the intensity profiles of the Kossel lines at the intersection of them. The intensity profile of intersecting lines characterizes an anomalous X-ray transmission and is not a simple sum of individual lines. The revealed effect is most sharply defined for type 1b diamond crystals (having a nitrogen impurity in the lattice). The experimental data on the X-ray diffraction by diamond single crystals qualitatively fit the theoretical calculations of the X-ray diffraction by a single crystal of the cubic syngony in the three-beam region when an ultrasonic wave passes through the crystal. The anomalous distribution of the intensity over the three-beam region is attributed to the periodic deformation of the diamond lattice caused by a selective absorption of a nitrogen (boron) isomorphic impurity by a growing crystal.

Author

Single Crystals; Carbon; X Ray Diffraction

20030068616 NASA Glenn Research Center, Cleveland, OH, USA

Electronic Power System Application of Diamond-Like Carbon Films

Wu, Richard L. C.; Kosai, H.; Fries-Carr, S.; Weimer, J.; Freeman, M.; Schwarze, G. E.; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 324-327; In English; See also 20030068525; Original contains color illustrations

Contract(s)/Grant(s): F33615-98-C-2818; No Copyright; Avail: CASI; A01, Hardcopy

A prototype manufacturing technology for producing high volume efficiency and high energy density diamond-like carbon (DLC) capacitors has been developed. Unique dual ion-beam deposition and web-handling systems have been designed and constructed to deposit high quality DLC films simultaneously on both sides of capacitor grade aluminum foil and aluminum-coated polymer films. An optimized process, using inductively coupled RF ion sources, has been used to synthesize electrically robust DLC films. DLC films are amorphous and highly flexible, making them suitable for the production of wound capacitors. DLC capacitors are reliable and stable over a wide range of AC frequencies from 20 Hz to 1 MHz, and over a temperature range from .500 C to 3000 C. The compact DLC capacitors offer at least a 50% decrease in weight and volume and a greater than 50% increase in temperature handling capability over equal value capacitors built with existing technologies. The DLC capacitors will be suitable for high temperature, high voltage, pulsed power and filter applications. Author

Carbon; Capacitors; Electrical Resistivity

20030068617 Kochi Univ. of Technology, Tosayamada, Japan

Application of Diamond Like Carbon Films to Gas Barrier for Hydrogen Fuel Cell Technology

Hatta, Akimitsu; Matsuhisa, Haruka; Kaneko, Tetsuya; Watamori, Michio; Koga, Yoshinori; Inagaki, Hironobu; Fukuda, Kenzo; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 328; In English; See also 20030068525; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

We propose application of diamond like carbon films to Hydrogen fuel cell technology. The Hydrogen fuel cell has been developed for a new style of clean energy. The Hydrogen storage system is one of important issues especially for the vehicles. The leakage of Hydrogen through the tank wall cannot be disregarded at such a high pressure of 40-70 MPa. The brittle fracture by Hydrogen is a serious problem for safety. For such the small molecule as hydrogen, the lighter elements such as

Beryllium, Boron, Carbon, Nitrogen, etc, will perform better barrier from diffusion into the material. DLC film is a promising barrier to prevent Hydrogen diffusion into the substrate. The Hydrogen leakage through DLC films deposited on polymer sheets has been investigated for the purpose of evaluation of hydrogen barrier by the DLC film. Without the DLC film, Hydrogen can easily pass through such the sheet of polyethylene terephthalate (PET) widely used for bottling drink. With a thin DLC film deposited by an RF plasma CVD method, the leakage rate through the sheet is decreased by more than 30%. Even by a thin film of a few 10 nm, the Hydrogen diffusion was partly stopped. It is necessary to optimize fabrication condition to improve the barrier performance.
Author
Diamond Films; Clean Energy; Diffusion; Hydrogen

20030068619 Fraunhofer-Inst. fuer Schicht- und Oberflaechentechnik, Brunswick, Germany
Cubic Boron Nitride and Boron Based Tool Coatings: Mechanical and Tribological Properties
Keunecke, Martin; Bewilogua, Klaus; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 329; In English; See also 20030068525; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

Due to their broad range of mechanical properties, from very soft e.g. hexagonal boron nitride, to very hard, e.g. titanium diboride or especially cubic boron nitride (cBN), boron based coatings can be applied in a wide range of cutting operations. The soft coatings can be used as a dry lubricant for cutting operations. The very hard modifications are suitable for wear resistant coatings on cutting tools for highly abrasive machining operations. After a short overview of the relevance of cBN in production engineering and future trends we will present in detail the current status of development of cBN coatings. Different ways for cBN deposition will be discussed, including the research results of the Fraunhofer IST. Using a modified sputter technique and a special B-C-N gradient interlayer, an essential adhesion improvement of the cBN top layer has been achieved. Our new process allows to prepare cBN films thicker than 2 m on silicon and nearly 1 m on cemented carbide cutting inserts. Measurements of mechanical properties like hardness and Young s modulus reveal that the properties of the cBN films are nearly identical to those of cBN bulk material. Results of cutting and machining tests for cBN and other boron based tool coatings will be presented.
Author
Boron Nitrides; Tribology

20030068623 Saarland Univ., Saarbruecken, Germany
From Molecules to Materials: Hard and Soft Boron Nitride Phases of Technological Importance
Sachdev, Hermann; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 330; In English; See also 20030068525; Original contains black and white illustrations; No Copyright; Avail: CASI; A01, Hardcopy

Boron Nitride (BN) displays several phases of industrial importance, e.g. phases with threefold coordinated atoms (h-BN, r-BN, o-BN) display high thermal resitance, low friction and good insulating properties, whereas phases with tetracoordinated atoms (c-BN, w-BN) exhibit extreme hardness and can be used as wear resistant coatings. Due to these interesting thermal, electrical and tribological features, films and layers of these materials are of specific interest1,2. In order to enhance a growth of hard phases (c-BN, w-BN) from the gas phase or at ambient pressure, it is important to understand the nucleation and growth mechanisms and avoid the formation of sp2- type BN 3,4,5. Due to the outstanding material properities of the individual BN phases, there is a huge interest in the specific synthesis of the individual modifications, and in general mainly infrared spectroscopy is used to determine the formation of c-BN films and nanoscale powders2,6,7. A critical analysis of the characterization of the individual BN phases with IR- and Raman-spectroscopy is presented and their use and limitations are discussed8. In the case of c-BN, polytypism was oberved for the first time with raman spectroscopy in analogy to silicon carbide (SiC)9, and the formation of boron nitride phases by chemical vapor deposition (fig. 1) and by thermal decomposition of suitable precursors is presented. Amorphous boron nitride was obtained at temperatures below 400 C (fig. 2), which does not show recrystallisation by heating up to 1500 C. SEM, XRD- and IR- spectra indicate the formation of sp2- type boron nitride and display a new source for the selective formation of BN based nanoscale materials. By CVD of borazines, a selective formation of monoatomic layers of h-BN was achieved. Furthermore, the syntheses of boron nitride nanotubes and boron nitride based ceramic composites are presented. These investigations and studies are of principle interest for the understanding of the nucleation and growth of the distinct crystalline phases of BN.
Author
Boron Nitrides; Nanotubes; Crystal Growth; Tribology; Crystal Structure

20030068625 Academy of Sciences of the Ukraine, Kiev, Ukraine

Electron Paramagnetic Resonance: An Aid in Solving Topical Problems of Diamonds

Nachalna, Tamara Artemevna; Novikov, N. V.; Podzyrey, G. A.; Malogolovets, V. G.; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 546; In English; See also 20030068525; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

We have developed a nondestructive method for identification of diamonds of various origins, which is based on analysis of the EPR data on impurities, defects, ferromagnetic inclusions, resistance of the defect-and-impurity states of diamonds to external actions as well as on peculiarities of distribution, interaction, relaxation and cross-relaxation of paramagnetic centers. The suggested method allows a practically complete identification of the diamond sample, i.e., it answers the following questions: is the crystal a natural or a synthetic diamond? Has it formed under static or dynamic conditions? What is the degree of the development and activity of the sample surface? What ferromagnetic materials are contained in the growth system (hence, a possible manufacturer)? Has been the test sample subjected to an additional external action? etc. We have considered some topical problems, in solving of which the developed method of identification proved to be efficient (at: synthesis of diamond, exploration and development of new deposits, customs examination, ascertainment of the authenticity of the museum displays, sorting of diamonds, etc.).

Author

Electron Paramagnetic Resonance; Diamonds; Nondestructive Tests

20030068627 Japan Fine Ceramics Center, Japan

Formation and Analysis of Dense Boron Carbide Coatings With a Low Porosity Formed by Electromagnetically Accelerated Plasma Spraying

Kitamura, Junya; Usuba, Shu; Kakudate, Yozo; Yokoi, Hiroyuki; Yamamoto, Kazuhiro; Tanaka, Akihiro; Fujiwara, Shuzo; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 598; In English; See also 20030068525; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

Thick coatings, which are necessary for many industrial fields, are easily obtained using thermal spraying compared with other methods such as CVD and PVD. However, the porosity is relatively high in the spray coatings. The ambient gases passing through the many pores in the coating may damage a base substrate material, and the coating would be easily detached. We have obtained thick boron carbide (B4C) coating with a porosity of 3% using electromagnetically accelerated plasma spraying. In this study, by using smaller powder of 2 micron in diameter, dense B4C coatings are formed with a low porosity of less than 1%. The size of the pores is also drastically decreased.

Author

Boron Carbides; Coating; Porosity; Electromagnetism; Plasma Spraying

20030068628 Shanghai Jiao Tong Univ., China

Molecular Dynamics Simulation of Boron Implanted into Diamond

Li, Rong-Bin; Dai, Yong-Bin; Hu, Xiao-Jun; Sheng, He-Shen; He, Xian-Chang; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 320; In English; See also 20030068525; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

Molecular dynamic simulations, utilizing the Tersoff many-body potential, are used to investigate the microscopic processes of a single boron atom with energy of 500eV implanted into the diamond (001)2 1 reconstruction surface. We investigate the variations of the coordination number with time required for it to relax during and short after the B bombarding event with energy of 500 eV. We find from the number of threefold coordinated atoms that rearrangements of the atoms occurred while the temperature of the sample falls within the range 5000~1000K.The time spent in this temperature range is defined to be thermal spike life, which is estimated to be 0.18 ps. The lattice relaxations in the diamond (001) 2 1 reconstruction surface or near surface of simulated have been discussed. It shows that, the outermost layer atoms tend to move inward, and the other atoms move outward. The interplanar distance between the outermost layer and the second layer has been shortened by 15% compared with its starting interplanar distance. According to our simulation, we find that the implanted boron could exit in diamond stably and form <110> split-interstitial. Stress distribution in the calculated diamond configuration is inhomogeneous. After B implanted into diamond with energy of 500 eV, there is an excess of compressively stressed atoms in the lattice, which induces the total stress in the diamond lattice being compressive.

Author

Carbon; Boron; Ion Implantation

20030068630 Industrial Technology Center of Nagasaki Prefecture, Omura, Japan

Preparation and Properties of Diamond-Like Carbon Films from CH4, C2H4, and C2H2 with Plasma Source Ion Implantation

Baba, K.; Hatada, R.; Miyagawa, S.; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 340-344; In English; See also 20030068525; No Copyright; Avail: CASI; A01, Hardcopy

Diamond-like carbon (DLC) films were prepared on silicon wafer substrates by plasma source ion implantation PSII) with superposed negative pulse. Methane, ethylene and acetylene gases were used as working gases for plasma. A negative DC voltage and a negative pulse voltage were superposed and applied to the substrate holder. The DC voltage was changed in the range from 0 to -4 kV and the pulse voltage was changed from 0 to -18 kV. The surface of DLC films was very smooth. The deposition rate of DLC films increased with increasing in superposed DC bias voltage. ID/IG ratios of Raman spectroscopy were around 1.5 independent on pulse voltage. The hydrogen concentration estimated by an elastic recoil detection (ERD) analysis was in the range from 20 at% to 28 at% depending on the source gas and the deposition condition. The hardness of around 10-20 GPa was derived for the film prepared with high DC and high pulse voltage. The friction coefficient estimated by a ball-on-disc test was around 0.1 for almost films. The residual stress was smaller than 1GPa (compressive) for all films and there was no clear dependence on working gas.

Author

Carbon; Ion Implantation

20030068631 YNDALMAS, Moscow, Russia

Influence of Metals on Diamond to Graphite Phase Transformation

Nozhkina, A. Y.; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 591; In English; See also 20030068525; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

Transformation of diamond into graphite was investigated in the region of diamond metastability under the action of media chemically active to carbon in the temperature range from 770 K up to 2200 K and pressure range from 10(exp -3) Pa up to 3Gpa. I Y - III Y group metals of periodic system and oxygen were used as media chemically active relative to diamond. Methods of electron diffraction, chemical analyses, emission spectroscopy and X-ray phase analyses were used for determination of the reaction products. It was found that in the region of diamond metastability the stage of catalytic phase transformation of diamond into graphite took place during the Interaction between diamond and metal. Metals reduce activation energy for transition of diamond into graphite from 109.4kcal/mole to 77.4kcal/mole. Kinetic of phase transformation of diamond into graphite was investigated. Pressure does not considerably influence on the rate of phase transformation of diamond into graphite in the presence of transition metals. It is established that catalytic action of transition metals and silicon considerably increases in the presence of oxygen during into graphite. Action energy is maximal for silicon (40 kcal/mole) and minimal for manganese (13 kcal/mole).

Author

Chemical Analysis; Diamonds; Activated Carbon; Graphite; Metastable State; Phase Transformations; Transition Metals

20030068635 Osaka Univ., Suita, Japan

Electrical Effect of Vacuum-Evaporated Alpha-NPD on Oxygen-Terminated Boron-Doped Chemical-Vapor-Deposited Homoepitaxial Diamond Films

Chun, Min-Seung; Teraji, Tokuyuki; Ito, Toshimichi; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 152; In English; See also 20030068525; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

Electrical properties of chemical-vapor-deposited (CVD) homoepitaxial diamond layers, based upon Hall effect measurements in the temperature range from 100 K to 300 K, have been investigated when an organic material, N,N-diphenyl-N,N- bis(1-naphthyl)- 1,1biphenyl- 4,4diamine (-NPD), was thermally deposited on them. In cases of O-terminated B-doped (p-type) diamond films with different carrier densities, substantial reductions in the electric conductivity due to hole density reductions were observed in the temperature range from 170 K to 200 K, where the Hall coefficients significantly changed. At temperatures higher than 200 K, however, it is found that the sheet conductivity of the substrate diamond layer was increased after the -NPD deposition to values larger than those measured before the -NPD deposition. These results indicate that a substantial amount of holes can be transferred from the CVD diamond film to the overlayered -NPD film when an appropriate interface was formed between the -NPD and diamond films. The possibility will be discussed that CVD diamond films can be applicable as a transparent anode material and a hole transport material with a

extremely high thermal conductivity and a strong chemical inertness for organic light-emitting diodes.
Author
Electrical Properties; Vapor Deposition; Diphenyl Compounds; Boron; Diamond Films; Doped Crystals

20030068650 Nippon Inst. of Tech., Japan
Electrical Discharge Machining Using Electrically Conductive CVD Diamond as an Electrode
Suzuki, Kiyoshi; Iwai, Manabu; Sharma, Anurag; Uematsu, Tetsutaro; Shoda, Kazuo; Kunieda, Masanori; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 222-227; In English; See also 20030068525; Original contains color and black and white illustrations; No Copyright; Avail: CASI; A02, Hardcopy

In order to improve electrical discharge machining (EDM) operation efficiency and accuracy along with the possibility of realizing a good quality surface, electrically conductive thick CVD diamond film was employed for the very first time as an electrode in die sinking EDM operation. This CVD diamond film of 0.5mm thickness, having a very high coefficient of thermal diffusivity and a low specific resistance suitable for carrying out EDM operation, has recently become commercially available. Die sinking EDM on high speed steel (SKH51, HRC63) was performed using this electrically conductive CVD diamond film as an electrode. Significantly high stock removal rate can be achieved along with virtually no wear of the CVD diamond electrode using kerosene oil as working fluid for various pulse durations at reversed polarity (workpiece: negative). The EDM can be performed at high current densities (~10A/mm2), which are impossible with copper and graphite electrodes. Significantly high stock removal rate of 0.11mm3/min along with an insignificant amount of electrode wear shows an excellent possibility of successful application of the CVD diamond electrode at reversed polarity. On the other hand, when this electrically conductive CVD diamond is used as a workpiece in EDM with the diamond or copper electrode, an excellent shape control along with insignificant amount of electrode wear can be achieved. From the overall results of the experiments it can be concluded that the electrically conductive CVD diamond film has a great future potential application as an electrode material in micro EDM.
Author
Diamond Films; Film Thickness; Vapor Deposition; Machining; Crystal Structure

20030068655 Academy of Sciences (Russia), Novosibirsk, Russia
Formation of Refractory Coatings on Carbon-Based Materials by Gas Phase Transport Reactions
Baklanova, N. I.; Kulyukin, V. N.; Zima, T. M.; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 367-371; In English; See also 20030068525; Original contains black and white illustrations; No Copyright; Avail: CASI; A01, Hardcopy

Increased oxidation resistance at high temperatures is one of the critical requirements for high-tech application of carbon materials including carbon and silicon carbide fibers, nanotubes, diamonds. Corrosion resistant coatings such as refractory carbides, nitrides, borides and oxides may improve the oxidation behavior of carbon-based materials. The aim of this work is to study theoretical and experimental aspects of the formation of refractory coatings on different carbon materials under chemical transport through the gas phase. The formation of coatings composed from the carbides of metals of IV-V groups (V, Nb, Ta, Ti, Zr, Hf, Cr, Si) on carbon and SiC fibers, diamond and graphite substrates are considered. The coatings were examined by X-ray diffraction (XRD), scanning electron microscopy (SEM). The coatings obtained were found to be uniform and adherent to substrates. Under definite conditions the formation of refractory coatings as needles was observed. Oxidation of coated carbon fibers was studied.
Author
Refractory Coatings; Carbon Fibers; Gas Injection; Oxidation Resistance; High Temperature

20030068659 Tokyo Univ., Japan
Nucleation Mechanism of Cubic Boron Nitride in Vapor Phase Deposition
Yang, Hangsheng; Iwamoto, Chihiro; Yoshida, Toyonobu; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 378; In English; See also 20030068525; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

Cubic boron nitride (cBN) thin films were deposited on ultrathin Si flake substrates by inductively coupled plasma-enhanced chemical vapor deposition. The prepared films were sufficiently thin for direct HRTEM observation without inducing damage in the cBN films. Isolated cBN nuclei as small as 1 nm layer were observed on the textured tBN. The surface of cBN films was pure cubic phase without sp2-bonded BN, contrary to the so-called subsurface growth mechanisms. The

chemical species responsible for cBN growth were analyzed by quadrupole mass analysis with ion energy analyzer (QMA-EA). QMA-IE analyses revealed that the boron source, B2H6, was totally ionized under the deposition conditions, while N2 was only partly ionized. The existence of neutral species such as N2 molecules inhibited cBN nucleation and growth. The introduction of Ar into the deposition system increased the N2 ionization yield markedly, which reduced the sp2-bonded BN formation from neutral N2 molecules on the growth surface and promoted cBN growth. In summary, both damage-free HRTEM observations and QMA-IE analyses suggest that cBN nucleates at a top surface rather than in subsurface region in vapor phase deposition.
Author
Nucleation; Boron Nitrides; Vapor Phases; Vapor Deposition; Thin Films; Substrates

20030068662 Tokyo Inst. of Tech., Tokyo, Japan
Tribological Properties of Segment-Structured Diamond-Like Carbon Films
Aoki, Yuichi; Ohtake, Naoto; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 423-428; In English; See also 20030068525; Original contains black and white illustrations; No Copyright; Avail: CASI; A02, Hardcopy

Diamond-like carbon (DLC) have been widely recognized as a tribo-coating material with a high wear resistant solid lubricant with a low friction coefficient. The tribological behavior of DLC films depends on the environmental conditions, the nature of the coating, and mechanical properties of a substrate. Particularly, when the DLC films are distorted with the deformation of the soft substrate, it is apparent that fragile DLC films are strongly damaged. In this study DLC films have been deposited by RF-plasma CVD with a methane gas on the soft material substrates, such as a rubber and aluminum, and the friction and wear tests were conducted using a ball-on-disk test. In the case of rubber substrate, DLC films show relatively low friction coefficient from 0.2 to 0.3, despite of large substrate deformation. Observation results of the surface of the rubber substrates suggest that the DLC film forms a 'segment structure' automatically, then 'segment structure coating' was applied to aluminum substrate. Ball-on-disk test results revealed that wear resistance of the segment-structured DLC film was about two-fold higher than that of a conventional continuous DLC coating.
Author
Tribology; Diamond Films; Carbon; Thick Films; Coating

20030068666 Kurchatov (I. V.) Inst. of Atomic Energy, Moscow, USSR
Identification of Chemical Bonds on Upper Layers of DLC Using Auger Spectroscopy and XPS
Dementjev, A. P.; Maslakov, K. I.; Uemura, Kensuke; Trakhtenberg, I. Sh.; Rubshtein, A. P.; Plotnikov, S. A.; Vladimirov, A. B.; Yugov, V. A.; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 345-349; In English; See also 20030068525; No Copyright; Avail: CASI; A01, Hardcopy

Hydrogen free DLC were deposited by solid carbon arc sputtering system. The DLC samples have been examined by N(E)CKVV Auger spectroscopy and Electron energy loss spectra of C1s XPS (EEL of C1s). According the CKVV data, concentration of the sp3 bonds averages 60% - 70%. The EEL of C1s XPS spectra have not - plasmon feature that is the inherent peculiarity of C=C bonds. Obviously, these data are showing the evidence of absence of the sp2-bonds in traditional understanding. The DLC samples were heated in-situ up to 800K or Ar ion etched. The CKVV showed the transformation of sp3 bonds from 70% to 0% but EEL of C1s XPS did not show the plasmon formation. The results are showing the evidence of DLC decomposition only on upper layers.
Author
Carbon; Chemical Bonds

20030068667 Academy of Sciences (USSR), Moscow, USSR
Measurements of Thermal Conductivity of Undoped and Boron-Doped CVD Diamond by Transient Grating and Laser Flash Techniques
Ralchenko, V. G.; Vlasov, A. V.; Ivakin, E. V.; Sukhadolau, A. V.; Khomich, A. V.; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 309-314; In English; See also 20030068525
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In plane and perpendicular thermal conductivity of high quality polycrystalline diamond films have been measured using transient thermal grating and laser flash techniques. Undoped and boron-doped films have been grown by microwave plasma chemical vapor deposition. In the thermal grating tests the films were excited in bulk by Nd:YAG laser pulses at 1064 and

266nm, and the laser flash tests used 1064 nm radiation. The in plane thermal conductivity values average over the film thickness (0.3-0.5 mm) fall in the range of 15-20 W/cmK at room temperature. The anisotropy of 10-20% in thermal conductivity caused by specific columnar growth of diamond grains is revealed. Using a quasi-surface thermal grating excitation in VUV spectral range (213 nm wavelength) in plane thermal conductivity values of thin sub-surface layers were measured and the depth nonhomogeneity of thermal conductivity was estimated. A strong variation of in plane thermal conductivity across the film thickness is revealed for some specimens. Thermal conductivity as high as 22.4 W/cmK is measured at the growth surface of a beta doped film.
Author
Vapor Deposition; Doped Crystals; Boron; Diamond Films; Thermal Conductivity

20030068668 Chongqing Univ., China
Study on Template Pore Acting on the Fabricated Arrays of Nanomaterials
Zhu, Y. B.; Wang, W. L.; Liao, K. J.; Hu, C. G.; Feng, Q.; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 80-86; In English; See also 20030068525; Original contains color illustrations
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In this work, the features of template approach are discussed. Then the influences of density and sizes of their pores on the emission of fabricated arrays are theoretically studied. Especially, the emission from the arrays of carbon nanotubes or silicon nanowires was mainly discussed. Their tip electric field, electric field enhancement factor and optimum array density are wholly presented with analytic equations. The theoretical results showed that the field electron emission properties of carbon nanotube or silicon nanowire arrays are closely related to template pore density. When the pore density is near to the optimum array density, the fabricated arrays will have better electron emission and their field enhancement factor may be sharply improved. It was found the length and the radius of pores having different effect on the emission. It was certain that the pore radius played more effective role. A uniformly distributed model about templates and nanomaterial arrays was introduced, and applied into the concrete analysis of some carbon nanotube array samples with satisfactory results.
Author
Carbon Nanotubes; Electron Emission

20030068669 Academy of Sciences (USSR), Moscow, USSR
Dielectric Losses in CVD Diamonds at Frequencies 1 kHz - 200 GHz and Temperatures 70 - 800 K
Garin, B. M.; Parkhomenko, M. P.; Parshin, V. V.; Myasnikova, S. E.; Heidinger, R.; Danilov, I.; Molla, J.; Ralchenko, V. G.; Derkach, V. N.; Tarapov, S. I.; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 297-302; In English; See also 20030068525
Contract(s)/Grant(s): INTAS-01-2173; Proj. 40.020.1.1.1160; No Copyright; Avail: CASI; A02, Hardcopy

The low loss materials for output windows still remains to be a weak point in megawatt millimeter waves gyrotrons for controlled plasma heating in fusion reactor. CVD diamond is considered currently as the most promising material for such windows. We determined its dielectric properties in extremely broad frequency and temperature ranges and compared with theory. The combinations of data on dielectric losses in broad frequency and temperature ranges give most information on the loss mechanisms. To measure the loss tangent from 1 kHz up to 200 GHz and temperatures 70 . 800 K different types of resonator technique were used. The diamond wafers were prepared by different producers using a microwave plasma CVD technique. The record breaking low values of loss tangent were observed (tan ~ 4.5.10.6 at T = 300 K, f = 170 GHz). However they are still one order of magnitude higher than the theoretical lower loss limit for diamond. Frequency and temperature dependencies of loss tangent in other materials with diamond-like lattice (Au-doped Si, compensated GaP, InP, GaAs, and Au-doped Si) were measured and analyzed for better understanding of the loss mechanisms. In addition, a semiconducting boron-doped CVD diamond has been also measured as a model material. The dielectric loss mechanisms and application to gyrotron windows are discussed.
Author
Vapor Deposition; Diamond Films; Gallium Arsenides; Doped Crystals

20030068677 City Univ. of Hong Kong, Hong Kong
Semiconducting Tetrahedral Carbons Transformed to Semimetal Nanocomposite Materials by Ion Implantation
Kutsay, O.; Bello, I.; Lifshitz, Y.; Luk, W. Y.; Lam, C. W.; Lee, S. T.; Meng, X. M.; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 353; In English; See also 20030068525; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

The transformation of the semiconductor tetrahedral carbon (ta-C) films to semimetal nanostructures induced by ion beam implantation at high doses has been studied. The structural analysis shows that originally abundant sp3 carbon atomic bonding of ta-C is gradually converted to a graphitic phase during the course of ion bombardment. The atomic scale analysis of implanted amorphous films shows the formation of structure with the higher degree of order. The graphitic basal planes are formed preferably along the ion tracks. Studying the mechanism of the ion-beam structuring shows that the critical damage for the transformation onset is 0.24 atomic displacements per an incident ion. The displacement and subplantation of carbon atoms are tools of nanostructuring and driving forces for the conversion of short ordered sp3 bonding configuration to the higher degree of an ordered structure when proper ion energies and doses are applied. As a result the resistivity can be altered from the original resistivity of 1010 to 10-4 ohm-cm at highest doses. The modification in resistivity is consistent with the change from interband to intraband absorption due to band overlapping which suggests the transformation from semiconductor to semimetal. Interesting is that the implanted structure with remaining sp3 bonding retains its high harness which is about 20 GPa.
Author
Carbon; Nanocomposites; Electrical Resistivity

20030068678 Agency of Industrial Science and Technology, Tsukuba, Japan
Nano-Graphite Deposition by Electron Cyclotron Resonance Plasma Sputtering Method
Ohana, T.; Nakamura, T.; Tanaka, A.; Koga, Y.; Tsugawa, K.; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 354-358; In English; See also 20030068525; Original contains black and white illustrations; No Copyright; Avail: CASI; A01, Hardcopy

The diamond-like carbon (DLC) films are of interest in connection with protective materials. Previously, we reported the deposition of DLC and carbon nitride films using an electron cyclotron resonance (ECR) plasma sputtering method. The deposited DLC film at low-pressure atmosphere showed low friction. In this paper, we investigated the deposition of carbon films under the condition of high plasma density and high-pressure atmosphere using ECR plasma sputtering. High density of plasma with low electron temperature was obtained in neighborhood of the substrate by the control of the magnetic flux density. The nanocrystal graphite in size about few nm was deposited on the Si (1 0 0) substrates by the sputtering of graphite target in argon atmosphere at room temperature.
Author
Graphite; Nanocrystals; Sputtering

20030068679 National Inst. of Advanced Industrial Science and Technology, Tsukuba, Japan
CN(x) Films Prepared Alternative Irradiation of 12C(+) And 14N(+) Ion Beams
Yamamoto, Kazuhiro; Koga, Yoshinori; Watanabe, Toshiya; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 359-364; In English; See also 20030068525; Original contains black and white illustrations; No Copyright; Avail: CASI; A02, Hardcopy

Carbon nitride(CNx) films were deposited on Si(100) wafers by means of alternative irradiation of mass-separated low energy 12C(sup +) and 14N(sup +) ion beams at the ultra-high vacuum pressure 10(exp -7) Pa. The influence of substrate temperature during deposition on the structure, composition, and chemical bonds of the films was investigated. The ion energy of both ion species was 50 eV. The Si substrate was kept at room temperature (RT), 460, 800, or 1130 K during deposition. The films were characterized by transmission electron microscopy (TEM), X-ray diffraction (XRD), electron energy-loss spectroscopy (EELS), and X-ray photoelectron spectroscopy (XPS). The carbon and CNx film prepared at rt was amorphous. The amorphous carbon films changed to a graphite-like one with the random crystal orientations when the substrate temperature is increased. The amorphous CN film prepared at rt consisted of sp(sup 2) C. N, sp(sup 3) C.N, sp(sup 2) C.C, and sp3 C.C bonds, whose bond angles were distorted. This distortion of the chemical bonds decreased, and the structure of the CNx film changed to a graphite-like one on increasing the growth temperature. The graphite-like CN(x) film has a highly preferential crystal orientation, and the c-axis of the graphite basal plane is parallel to the film growth surface. The basal plane is also curved and interlinked because of the presence of in-plane sp(sup 2) C.N and three-dimensional sp(sup 3) C.N bonds.
Author
Thin Films; Ion Beams; Carbon Nitrides; Amorphous Materials

20030068681 Ishikawajima-Harima Heavy Industries Co. Ltd., Yokohama, Japan
Tribological Properties of Pulse-Biased Hydrogenated Amorphous Carbon Films
Wazumi, Koichiro; Fuchigami, Kenji; Tanaka, Akihiro; Koga, Yoshinori; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 436-439; In English; See also 20030068525; Original contains black and white illustrations; No Copyright; Avail: CASI; A01, Hardcopy

Hydrogenated amorphous carbon films have been prepared on Si substrates in plasma CVD system by using pulse bias techniques. ERDA analysis showed that pulse-biased film prepared at a duty ratio of 10% included large amount of hydrogen compared to the dc-biased films prepared at the same bias voltage of .1kV. Mechanical properties showed that the density, hardness and internal stress of pulse-biased films decreased compared to the dc-biased films. The film hardness decreased from 33 Gpa of dc-biased one to 15.5 Gpa in pulse-biased one. Film stress decreased from 2.9 Gpa for dc-biased one to 0.5 Gpa for pulse-biased one. Tribological properties by a ball-on-disk friction tester in the dry air condition showed that friction coefficient of dc-biased film with a counterpart of SiC ball was 0.06 and that of pulse-biased films was 0.045, which did not show clear difference. However the specific wear rate had a much difference between these two films. The wear rate of dc-biased films was 6 x 10-8 mm3/Nm and that of pulse one is 5 x 10-9 mm3/Nm showing the extremely low wear in dry air condition. The reason was thought to be due to the decrease of internal stress of the films because of the increase of hydrogen content and the existence of mixed structures of hydrocarbon bonding.
Author
Carbon; Tribology; Hydrogenation

20030068688 Saarland Univ., Saarbruecken, Germany
Influence of Impurities on the Morphology and the Raman Spectra of Cubic Boron Nitride
Sachdev, Hermann; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 380; In English; See also 20030068525; No Copyright; Avail: CASI; A01, Hardcopy

It is still a challenging problem to understand the growth mechanisms of cubic boron nitride (c-BN) in the high pressure high temperature (HPHT) synthesis as well as to develop film deposition techniques (CVD- or PVDmethods) of microcrystalline c-BN layers for protective or abrasive applications. It is possible to grow cm- seized diamond single crystals by HPHT- methods and to achieve microcrystalline diamond films by CVD- or PVDmethods with good mechanical properties1, but regarding c-BN, even in the HPHT- process it is not possible to obtain well grown, large single crystals2 and up to now, film deposition methods lead only to the formation of nanocrystalline c-BN layers of weak quality. The structural analogy between carbon- and boron nitride sp2-and sp3- phases is only valid regarding their physical and mechanical properties, but there is a significant difference in their syntheses3,4. In order to enhance and modify c-BN growth, the understanding of the growth mechanism is of significant importance5. A detailed Raman spectroscopic characterization of HPHT- c-BN samples with distinct morphology and facettation indicates a correlation between crystal impurities and the resulting morphology. The results reveal a strong anisotropy of <100>- and <111>- growth directions of c-BN, which are affected by crystal impurities and their nature will be discussed (fig. 1). The presented study reveal significant information to modify c-BN growth and to realize the growth of microcrystalline films of cubic boron nitride.
Author
Boron Nitrides; Crystallinity; Morphology

20030068691 Jilin Univ., Changchun, China
Investigation of Structure and Field Emission Characteristics of Diamond-Like Films Prepared by High Power Excime Laser
Peng, H. Y.; Jin, Z. S.; Li, J. J.; Ji, H.; Shen, H.; Zhao, L. X.; Shen, J. J.; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 494; In English; See also 20030068525; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

Diamond-like films have been prepared using high power and high frequency XeCl excime laser under high vacuum H2 and N2 gas environment, respectively. The bonding structure of the films was studied by Raman spectrum and electron diffraction method. The results show that the films have typical characteristics of DLC contained nano-diamond grains. The measurement result of field emission show that the threshold electric filed is reduced with increasing laser power at 108 W/cm2 ~ 1010 W/cm2, and 300 HZ. The threshold electric filed is 2 V/ m when 10 10 W/cm2 laser power is applied in the experiment.
Author
Diamond Films; Carbon

20030068694 National Inst. for Materials Science, Tsukuba, Japan
Cubic BN Single Crystals and Sintered Bodies Synthesized at High Pressure
Taniguchi, Takashi; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 382; In English; See also 20030068525; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

Single crystals and sintered bodies of cBN were synthesized under high pressure and high temperature. For the growth of single crystals, temperature gradient method was applied at 5GPa and 1600 C for 20-100 hrs. Be doped crystals exhibit p-type semiconducting properties and S-doped and unintentionally doped crystals exhibit n-type properties, as characterized by Hall measurements. Although the origin of the donor level is not qualified yet in the unintentionally doped crystals, oxygen, carbon, or nitrogen vacancy may be the candidate for the donor. It was found that additive of Be atoms were localized as acceptor in particular growth sectors of the crystals. Consequently, self-organized p-n domains were realized in the Be-doped crystals showing ultra-violet light emission by inducing current across the sector boundaries. Some advancement has also been achieved to obtain colorless crystal, which has very high electrical resistivity and exhibiting band edge nature in optical properties. In view to practical application of cBN, improvement of the mechanical properties of the sintered body is important. It can be seen that optimization of sintering conditions, such as pressure, temperature, and initial grain size will allow us to fabricate binder-less bodies with fine-grained structure. Recent progress of synthesis of finegrained cBN sintered body without binder will be also described.

Author

Boron Nitrides; Crystal Growth

20030068697 Harbin Inst. of Tech., China

The Microstructure and Properties of Tetrahedral Amorphous Carbon Films Deposited by Filtered Arc Accelerated at Different Energetic Grades

Zhu, Jia-Qi; Han, Jie-Cai; Meng, Song-He; Li, Qiang; Zheng, Wei-Tao; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 512-520; In English; See also 20030068525; Original contains black and white illustrations; No Copyright; Avail: CASI; A02, Hardcopy

Tetrahedral amorphous carbon films were deposited on single crystalline silicon substrate by the species with the different impinging energetic grades produced by the static-electricity pulse negative bias from 0 to 2000 V. The microstructure of the ta-C films is the amorphous sp3 hybridization skeleton enchased with sp2 clusters whose inplane correlation length is less than 1 nm in light of visible Raman spectroscopic measurement. At the low energetic grade, the sp3-rich energetic window, and the sub-high energetic grade, the more is the content of sp3 in the films, the smoother is the surface of the films. The dependence between the impinging energy of the species and the surface morphology can be illustrated perfectly according to subimplantation growth mechanism. Nevertheless at the high energetic grade, the impinging ions with appropriate energy and angle can sputter and smoothen the surface, the roughness is even lower than the one of the films with the richest sp3. The hardness and Young.s modulus of the films deposited at the high energetic grade (-2000 V) are higher than those of the films prepared at the floating conditions. Simultaneously, the critical scratching load of the films deposited with the substrate bias of 2000 V is even larger than the one of the sp3-rich films.

Author

Carbon; Microstructure

20030068701 National Inst. of Advanced Industrial Science and Technology, Tohoku, Japan

Persistence of Graphite Phase in G-Ball Under High Pressure Showing Metallic Behavior

Nakayama, Atsuko; Shimizu, Katsuya; Matsuoka, Takehiro; Kokai, Fumio; Koga, Yoshinori; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 381; In English; See also 20030068525; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

Graphitic-carbon polyhedrons G-balls are supposed to have a closed-shell framework of graphite according to TEM image. It is expected that high-pressure structural-change of G-balls is topologically different from that of graphite. High-pressure x-ray powder-diffraction measurements of G-balls has been carried out at room temperature. In addition, the temperature dependences of electrical resistances were obtained in order to investigate the relationship between structures and electronic properties. The graphite phase in G-balls is very stable and does not have the phase transition even if the pressure is higher than 40 GPa. The volume reduces by 29 % at 43 GPa. The value of bulk modulus, B0, is determined to be B0=41.5 GPa. G-balls are geometrically difficult to cause the side-splitting between graphene sheets in comparison with graphite, resulting in absence the phase transition. Electrical resistance measurements exhibit the metallic behavior of G-ball at the pressure above 20 GPa at room temperature. The c-axis length shortens by 18 % at 20 GPa, which means the extraordinary overlapping between carbon pi-orbitals.

Author

Carbon; Graphite; Polyhedrons

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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*.

20030067722 Johns Hopkins Univ., Baltimore, MD

Prediction of Cellular Dysfunction from Exposure to JP-8

Risby, Terence H.; Foster, W. M.; Burdick, James F.; Schnert, Shelley S.; Dec. 2002; 41 pp.; In English

Contract(s)/Grant(s): F49620-98-1-0403; Proj-2312

Report No.(s): AD-A414705; AFRL-SR-AR-TR-03-0172; No Copyright; Avail: CASI; A03, Hardcopy

During this past 4.5 years, research has been conducted with support from the Air Force Office of Scientific Research. This research has been focused upon assessing the health effects of exposure to jet fuel, JP-8 in military personnel. In addition, research has continued into identifying molecules in exhaled breath that serve as sentinels of exposure, susceptibility and disease. Exhaled breath is composed of many molecules in the gaseous matrix that consists of oxygen, nitrogen, water vapor carbon dioxide and the inert gases. Endogenously produced molecules are present in concentrations that are less than 100 parts per billion (v/v) whereas the concentrations of exogenous molecules are dependent upon the exposure concentration. Another important factor is that the composition of exhaled breath changes throughout the normal breathing cycle. The sources of endogenous molecules in exhaled breath may be systemic tissues or cells found at the alveolar membrane junction, in conducting airway, or in the oral-nasal-pharyngeal cavity. The sources of exogenous molecules in exhaled breath may be from previous or current inspiratory air.

DTIC

Exposure; Membranes

20030067761 Nebraska Univ., Omaha, NE, USA

Validated Numerical Models for the Convective Extinction for Fuel Droplets (CEFD)

Gogos, George; Bowen, Brent D.; Nickerson, Jocelyn S.; The Aeronautics Education, Research, and Industry Alliance (AERIAL) 2002 Report; November 2002, pp. 24-44; In English; See also 20030067758; Original contains black and white illustrations; No Copyright; Avail: CASI; A03, Hardcopy

The NASA Nebraska Space Grant (NSGC) and EPSCoR programs have continued their effort to support outstanding research endeavors by funding the Numerical Simulation of the Combustion of Fuel Droplets study at the University of Nebraska at Lincoln (UNL). This team of researchers has developed a transient numerical model to study the combustion of suspended and moving droplets. The engines that propel missiles, jets, and many other devices are dependent upon combustion. Therefore, data concerning the combustion of fuel droplets is of immediate relevance to aviation and aeronautical personnel, especially those involved in flight operations. The experiments being conducted by Dr. Gogos and Dr. Nayagam s research teams, allow investigators to gather data for comparison with theoretical predictions of burning rates, flame structures, and extinction conditions. The consequent improved fundamental understanding of droplet combustion may contribute to the clean and safe utilization of fossil fuels (Williams, Dryer, Haggard & Nayagam, 1997,y 2). The present state of knowledge on convective extinction of fuel droplets derives from experiments conducted under normal gravity conditions. However, any data obtained with suspended droplets under normal gravity are grossly affected by gravity. The need to obtain experimental data under microgravity conditions is therefore well justified and addresses one of the goals of NASA's Human Exploration and Development of Space (HEDS) microgravity combustion experiment.

Author

Mathematical Models; Gravitational Effects; Microgravity; Fuel Combustion

20030068156 California Univ., Berkeley, CA

Environmental Management Science Program. Mixing Processes in High-Level Waste Tanks

Peterson, P. F.; Jun. 01, 1998; 7 pp.; In English

Report No.(s): DE2003-13486; No Copyright; Avail: Department of Energy Information Bridge

Flammable gases can be generated in DOE high-level waste tanks, including radiolytic hydrogen, and during cesium precipitation from salt solutions, benzene. Under normal operating conditions the potential for deflagration or detonation from these gases is precluded by purging and ventilation systems, which remove the flammable gases and maintain a well-mixed condition in the tanks. Upon failure of the ventilation system, due to seismic or other events, however, it has proven more difficult to make strong arguments for well-mixed conditions, due to the potential for density-induced stratification which can

potentially sequester fuel or oxidizer at concentrations significantly higher than average. This has complicated the task of defining the safety basis for tank operation.
NTIS
Environment Management; Flammable Gases; Waste Management; Radioactive Wastes; Storage Tanks; Mixing

20030068507 National Advisory Committee for Aeronautics. Langley Aeronautical Lab., Langley Field, VA, USA
Rocket Power Plants Based on Nitric Acid and their Specific Propulsive Weights
Zborowski, Helmut; R-Antriebe, Schriften der Deutsche Akademie der Luftfahrtforschung; May 1947; No. 1071, Nr. 82, pp. 91-126; In English
Report No.(s): NACA-TM-1145; No Copyright; Avail: CASI; A03, Hardcopy

Two fields are reserved for the application of rocket power plants. The first field is determined by the fact that the rocket power plant is the only type of power plant that can produce thrust without dependence upon environment. For this field,the rocket is therefore the only possible power plant and the limit of what may be done is determined by the status of the technical development of these power plants at the given moment. The second field is that in which the rocket power plant proves itself the most suitable as a high-power drive in free competition with other types of power plants. The exposition will be devoted to the demarcation of this field and its division among the various types of rocket power plants.
Derived from text
Nitric Acid; Power Plants; Weight (Mass); Rocket Propellants; Propulsive Efficiency

20030068621 Max-Planck-Inst. fuer Chemie, Mainz, Germany, Carnegie Institution of Washington, Washington, DC, USA
Polymeric Nitrogen
Eremets, M. I.; Popov, M.; Trojan, I. A.; Denisov, V.; Dera, P.; Hemley, R. J.; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 597; In English; See also 20030068525; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

Common nitrogen consists of diatomic molecule in which atoms hold each other with the strongest triple covalent bonds. However, in principle, nitrogen atoms can be connected with single or double bonds creating a net of atoms similar to polymeric carbon. The non-molecular nitrogen phase has been recently synthesized at very high pressures about 150 GPa, but it can be recovered to atmospheric pressure due to the huge hysteresis of the transformation. In the present work in addition to the direct polymerization of N2 molecules we explore a different approach to the nitrogen polymerization: molecular N3 anions in the lattice of NaN3 have been squeezed at pressures up to 160 GPa at temperatures 10-300 K. Raman spectra, X-ray diffraction and electrical conductivity were measured in a diamond anvil cell. As a result of pressurizing to 120-160 GPa sodium azide transforms to new structures completely different from molecular consisted of linear N3 - molecules. These new nonmolecular phases preserve at release pressure to the lowest pressures in diamond anvil cell (less than 1 GPa) and some of them can be recovered. One of these structures (phase I) starts to form at 17 GPa. Raman bands at 1670 - 1850/cm are characteristic for this phase. It appears in the pure form (without signs of molecular ion azide) after pressurizing up to 120-160 GPa (or 80 GPa with subsequent large plastic deformation) and persists in the confined cell to the lowest pressures (0-1 GPa). Probably this phase is formed of strongly coupled azide ions forming new molecules or other clusters. In the 50 to 160 GPa pressure range the amorphous phase III is formed. The phase III is conductive; it is completely black and opaque. It partly transforms back to the phase I at 50 GPa upon pressure release. This phase is most probably formed by layers of polymeric nitrogen separated by layers of sodium atoms. Other observed phases are formed by different complexes of nitrogen.
Author
Polymerization; Nitrogen; Diatomic Molecules; Diamonds; Raman Spectra; High Pressure

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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*.

20030067889 Lockheed Martin Space Systems Co., Denver, CO, USA
CO2 Acquisition Membrane (CAM) Project
Mason, Larry W.; [2003]; 87 pp.; In English
Contract(s)/Grant(s): NAS8-00126
Report No.(s): MCR-00-509; No Copyright; Avail: CASI; A05, Hardcopy

The CO2 Acquisition Membrane (CAM) project was performed to develop, test, and analyze thin film membrane materials for separation and purification of carbon dioxide (CO2) from mixtures of gases, such as those found in the Martian atmosphere. The membranes developed in this project are targeted toward In Situ Resource Utilization (ISRU) applications, such as In Situ Propellant Production (ISPP) and In Situ Consumables Production (ISCP). These membrane materials may be used in a variety of ISRU systems, for example as the atmospheric inlet filter for an ISPP process to enhance the concentration of CO2 for use as a reactant gas, to passively separate argon and nitrogen trace gases from CO2 for habitat pressurization, to provide a system for removal of CO2 from breathing gases in a closed environment, or within a process stream to selectively separate CO2 from other gaseous components. The membranes identified and developed for CAM were evaluated for use in candidate ISRU processes and other gas separation applications, and will help to lay the foundation for future unmanned sample return and human space missions. CAM is a cooperative project split among three institutions: Lockheed Martin Astronautics (LMA), the Colorado School of Mines (CSM), and Marshall Space Flight Center (MSFC).
Author
Membrane Structures; Carbon Dioxide; In Situ Resource Utilization; Purification

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ENGINEERING (GENERAL)

Includes general research topics related 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*.

20030067682 IDEO, USA
Right-Rapid-Rough
Lawrence, Craig; ASK Magazine, No. 13; August 2003, pp. 12-16; In English; See also 20030067672; Original contains color illustrations; No Copyright; Avail: CASI; A02, Hardcopy

IDEO (pronounced 'eye-dee-oh') is an international design, engineering, and innovation firm that has developed thousands of products and services for clients across a wide range of industries. Its process and culture attracted the attention of academics, businesses, and journalists around the world, and are the subject of a bestselling book, The Art of Innovation by Tom Kelley. One of the keys to IDEO's success is its use of prototyping as a tool for rapid innovation. This story covers some of IDEO's projects, and gives reasons for why they were successful.
Author
Industries; Rapid Prototyping; Project Management

20030067718 Army Research Lab., White Sands Missile Range, NM, USA
PILOT-81 VVA EXPERIMENT-Analysis of the Multi-Path Transmissometer-Radiometer Measurements
Sutherland, R. A.; Butterfield, J. E.; Apr. 2003; 55 pp.; In English
Report No.(s): AD-A414693; ARL-TR-2953; No Copyright; Avail: CASI; A04, Hardcopy

This report presents results and finding from the PILOTS 1 Emissive Sources Verification Experiments carried out at the Survivability/Lethality Analysis Directorate (SLAD), U. S. Army Research Laboratory Tower site at the White Sands Missile Range during February 1999. The experiments involved (near) simultaneous measurements of direct transmittance and normalized path emission/radiance sampled over three slightly diverging lines of sight through intervening obscurants comprised of either graphite flakes or brass powers of varying concentration levels. Specifically this report presents measurements of direct transmission and total radiance obtained over four spectral bands from the visible through far infrared using the SLAD Multiple Path Transmissometers-Radiometer (MPTR) system augmented with a conventional dual band infrared scanning imager. From the combined transmissometers and radiometer results we are able to determine both the multi-band transmittance and normalized path radiance, or 'sky-to-ground' ratio, for cloud optical depths ranging from tau=O to about tau=8.
DTIC
Transmissometers; Radiometers

20030067915 NASA Marshall Space Flight Center, Huntsville, AL, USA
An Improved Design for Air Removal from Aerospace Fluid Loop Coolant Systems
Ritchie, Stephen M. C.; Holladay, Jon B.; Holt, J. Mike; Clark, Dallas W.; [2003]; 1 pp.; In English; 33rd International Conference on Environmental Systems, 7-10 Jul. 2003, Vancouver, British Columbia, Canada; No Copyright; Avail: Other Sources; Abstract Only

Aerospace applications with requirements for large capacity heat removal (launch vehicles, platforms, payloads, etc.) typically utilize a liquid coolant fluid as a transport media to increase efficiency and flexibility in the vehicle design. An issue with these systems however, is susceptibility to the presence of noncondensable gas (NCG) or air. The presence of air in a coolant loop can have numerous negative consequences, including loss of centrifugal pump prime, interference with sensor readings, inhibition of heat transfer, and coolant blockage to remote systems. Hardware ground processing to remove this air is also cumbersome and time consuming which continuously drives recurring costs. Current systems for maintaining the system free of air are tailored and have demonstrated only moderate success. An obvious solution to these problems is the development and advancement of a passive gas removal device, or gas trap, that would be installed in the flight cooling system simplifying the initial coolant fill procedure and also maintaining the system during operations. The proposed device would utilize commercially available membranes thus increasing reliability and reducing cost while also addressing both current and anticipated applications. In addition, it maintains current pressure drop, water loss, and size restrictions while increasing tolerance for pressure increases due to gas build-up in the trap.
Author
Cooling Systems; Liquid Cooling; Noncondensable Gases; Evacuating (Vacuum)

20030068003 Defence Research and Development Canada, Ottawa, Ontario, Canada
Threshold(trade mark) Immunoassays for Identification of Biological Agents: NATO SIBCA Exercise III
Thompson, H. G.; Fulton, R. E.; Dec. 2002; 35 pp.; In English
Report No.(s): AD-A414871; DRDC-TR-2002-008; No Copyright; Avail: CASI; A03, Hardcopy

In February 2001, the NATO Panel VII Subgroup on Sampling and Identification of Biological and Chemical Agents (SIBCA) conducted the third international training exercise on the identification of biological agents. Fourteen NATO national laboratories participated: Austria, Bulgaria, Canada, France, Germany (two laboratories), Italy, the Netherlands, Norway, Poland, Sweden, the UK and the USA (two laboratories). The designated laboratory for Canada was Defence R&D Canada - Suffield (DRDC suffield). Participant laboratories were sent seven samples, four liquid (including one buffer blank) and three solid, consisting of soil. Participants were advised that samples could contain any one of the following gamma-irradiated organisms: Bacillus anthracis, Yersinia pestis, Brucella melitensis, Francisella tularensis, Vibrio cholera, Burkholderia mallei; Venezuelan equine encephalitis (VEE) virus, Vaccinia virus, Coxiella burnetti, or Yellow fever virus. A number of immunologically-based technologies were used at DRDC Suffield for screening of sample unknowns, one of which was the Threshold(TM) assay, a Light Addressable Potentiometric Sensor (LAPS) assay. Antigen capture Threshold(TM) assays were available for five biological agents: Bacillus anthracis, Yersinia pestis, Brucella melitensis, Francisella tularensis, and Burkholderia mallet. Two biological agents were identified by Threshold(TM), both from the liquid samples (B. melitensis and F. tularensis). No 'false positive' or 'false negative' reactions were observed with SIBCA liquid samples. However, soil-extracted samples produced multiple 'false positive' reactions and one 'false negative' reaction, making identification of agents from this medium impossible to achieve.
DTIC
Potentiometric Analysis; Immunoassay

20030068264 Old Dominion Coll., Norfolk, VA, USA, Virginia Univ., Charlottesville, VA, USA, Jefferson (Thomas) Lab. Computer Center, Newport News, VA, USA
Several Technical Measures to Improve Ultra-High and Extreme-High Vacuum
Dong, C.; Mehrotra, P.; Myneni, G. R.; 2002; 10 pp.; In English
Report No.(s): DE2003-807887; No Copyright; Avail: Department of Energy Information Bridge

Achieving UHV/XHV without high temperature bake outs is becoming essential in many applications. In this study, we investigated the use of inexpensive silica and titanium oxide thin film coatings on UHV/XHV chambers/components to reduce the adsorption of water on the chamber walls. Water can be cracked into oxygen and hydrogen in the material and act as one of the sources of the hydrogen. We have also implemented backing of the turbo pump with an ion pump for reducing the vacuum chamber pump down times into UHV/XHV pressure range. The results of these investigations are summarized in the paper.
NTIS
High Vacuum; Vacuum Chambers; Titanium Oxides; Silicon Dioxide; Oxide Films; High Temperature

20030068305 Old Dominion Univ., Norfolk, VA, USA

Institute for Scientific and Educational Technology (ISET)-Education, Research and Training Programs in Engineering and Sciences

Tiwari, S. N., Principal Investigator; Massenberg, Samuel E., Technical Monitor; December 31, 2002; 38 pp.; In English

Contract(s)/Grant(s): NCC1-349

Report No.(s): ODURF #163632; No Copyright; Avail: CASI; A03, Hardcopy

The 'Institute for Scientific and Educational Technology' has been established to provide a mechanism through which universities and other research organizations may cooperate with one another and with different government agencies and industrial organizations to further and promote research, education, and training programs in science, engineering, and related fields. This effort has been undertaken consistent with the national vision to 'promote excellence in America s educational system through enhancing and expanding scientific and technological competence.' The specific programs are directed in promoting and achieving excellence for individuals at all levels (elementary and secondary schools, undergraduate and graduate education, and postdoctoral and faculty research). The program is consistent with the existing activities of the Institute for Computational and Applied Mechanics (ICAM) and the American Society for Engineering Education (ASEE) at NASA Langley Research Center (LaRC). The efforts will be directed to embark on other research, education, and training activities in various fields of engineering, scientific, and educational technologies. The specific objectives of the present program may be outlined briefly as follows: 1) Cooperate in the various research, education, and technology programs of the Office of Education at LaRC. 2) Develop procedures for interactions between precollege, college, and graduate students, and between faculty and students at all levels. 3) Direct efforts to increase the participation by women and minorities in educational programs at all levels. 4) Enhance existing activities of ICAM and ASEE in education, research, and training of graduate students and faculty. 5) Invite distinguished scholars as appropriate and consistent with ISET goals to spend their summers and/or sabbaticals at NASA Langley andor ODU and interact with different researchers and graduate students. Perform research and administrative activities as needed to carry out the above mentioned activities. 6) The implementation of various activities of the ISET programs is carried out through cooperative efforts between Old Dominion University (ODU) and the Office of Education at LaRC. At present, major efforts are directed on the following ISET Programs: ICAM Programs, Academic Programs, Educational Research, Outreach Programs, Educational Technology and Cooperative Programs. These programs are described in the following sections.

Author

Education; Universities; Engineering; Science

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*.

20030067713 Army War Coll., Carlisle Barracks, PA

Beyond the Port Support Activity; The Role of the Port Task Force in Conducting Reception, Staging and Onward Movement in Europe

Killian, Howard J.; Apr. 7, 2003; 45 pp.; In English

Report No.(s): AD-A414689; No Copyright; Avail: CASI; A03, Hardcopy

FM 100-17-3, Reception, Staging, Onward Movement and Integration (RSOI) loosely outlines possible command and control relationships. Doctrine and force structure must respond to the environment of small-scale contingencies as well as major combat operations. Military Traffic management Command has responsibility as the Port Manager, but has neither the structure nor span of control to cover all the tasks required to operate in the uncertain environment which characterized many of the former republics of Yugoslavia, the Warsaw Pact and even our NATO ally Greece. Critical combat support and combat service support structure needs to be placed back in the active duty component. In response to requirements in the Balkans, USAREUR's 21st TSC established an RSO organization to facilitate transfer of authority every six months. Based on this successful model, a port task force that includes all the JRSOI functions and also includes force protection responsibilities needs to be codified in Army doctrine. After a review of the strategic context, current doctrine and emerging concepts, the author will draw on his experience, as the commander of two operations, one for SFOR and one for KFOR, to document the roles, missions and functions of the USAREUR model.

DTIC

Combat; Command And Control; Support Systems

20030067750 Newcastle-upon-Tyne Univ., Newcastle

Design Analysis and Implementation of a Self-timed Duplex Communication System

Yakovlev, A.; Furber, S.; Krenz, R.; Feb. 2003; 24 pp.; In English

Report No.(s): PB2003-105173; CS-TR-761; Copyright; Avail: National Technical Information Service (NTIS)

The design of an asynchronous communication system using partially automated techniques is described in this paper. The protocol is formally specified as a protocol state machine and verified with respect to deadlock-freedom and delay-insensitivity using Petri net based model-checking tools. A protocol controller has been synthesized by direct mapping of the Petri net model derived from the protocol specification. The logic implementation was analyzed using the Cadence toolkit. While most of he controller's logic is robust to arbitrary gate delay variations, a number of speed-up strategies based on relative timing have been considered. The results of SPICE simulation show the advantages of the direct mapping method compared to logic synthesis. Overall, the design process suggested here offers a generic way to constructing asynchronous communication systems, for both on-chip and off-chip interconnects.

NTIS

Design Analysis; Duplexers; Communication Networks; Systems Engineering

20030067765 Newcastle-upon-Tyne Univ., Newcastle

Complete Specification of APIs and Protocols for the MAFTIA Middleware

Neves, N. F.; Verissimo, P.; Apr. 2003; 170 pp.; In English

Report No.(s): PB2003-105177; CS-TR-775; Copyright; Avail: National Technical Information Service (NTIS)

This document describes the complete specification of the APIs and protocols for the MAFTIA middleware. The architecture of the middleware subsystem has been described in a previous document, where the several modules and services were introduced: Activity Services; Communication Services; Network Abstraction; Trusted and Untrusted Components. The purpose of the present document is to make concrete the functionality of the middleware components by defining their application programming interfaces, and describing the protocols implementing the above-mentioned functionality.

NTIS

Protocol (Computers); Specifications; Computer Programming; Application Programming Interface

20030067769 Newcastle-upon-Tyne Univ., Newcastle

Conceptual Model and Architecture for MAFTIA

Powell, D.; Stroud, R.; Apr. 2003; 132 pp.; In English

Report No.(s): PB2003-105182; CS-TR-787; Copyright; Avail: National Technical Information Service (NTIS)

This report described the basic concepts of dependability and intrusion tolerance that underpin all of the MAFTIA work. These concepts and architectural principles reflect the experience gained from prototyping and validating selected components of the overall MAFTIA architecture.

NTIS

Program Verification (Computers); Intrusion Detection (Computers); Architecture (Computers); Mathematical Models

20030067785 Newcastle-upon-Tyne Univ., Newcastle

Compositional Verification of a Network of CSP Processes: Using FDR2 to Verify Refinement in the Event of Interface Difference

Burton, J.; Sep. 2002; 42 pp.

Report No.(s): PB2003-105189; CS-TR-758; Copyright; Avail: National Technical Information Service (NTIS)

The authors previously presented an implementation relation formalizing what it means for one process to 'implement' another in the CSP (Communicating Sequential Processes) framework in the event that the two processes have different interfaces. This implementation relation allows for compositional verification of a network of CSP processes. The model checker FDR2 may be used to check CSP refinement in the event that specification and implementation processes have the same interface. In this paper, the authors show how to transform the problem of checking the conditions from the implementation relation, where the specification and implementation processes have different interfaces, into one where the specification and implementation processes have the same interface. This allows the authors to take advantage of the existing tool FDR2 and allows automatic, compositional verification using the relation developed.

NTIS

Communicating; Computer Networks; Human-Computer Interface; Program Verification (Computers); Sequential Control

20030067791

Internet Security/Architecture Task Force Report: First Steps in Identifying and Remediating Vulnerabilities in Pervasive Software and Protocols

Apr. 04, 2003; 20 pp.

Report No.(s): PB2003-106127; No Copyright; Avail: CASI; A03, Hardcopy

At the President's National Security Telecommunications Advisory Committee (NSTAC) meeting in March 2002, the Special Advisor to the President for Cyberspace Security discussed the challenges of Internet security and the serious nature of the threats posed by vulnerabilities to pervasive protocols within the Internet infrastructure. In response to these concerns, the NSTAC formed the Internet Security/Architecture Task Force (ISATF) to provide policy recommendations to the President with respect to the vulnerabilities in pervasive software and protocols critical to the operation of the Internet. To accomplish its tasking, the ISATF developed this report, which includes recommendations on the need to improve current information sharing mechanisms so that the telecommunications industry and the Government are better able to quickly and thoroughly respond to and mitigate vulnerabilities before they are maliciously exploited.

NTIS

Internets; Protocol (Computers); Computer Information Security; Software Engineering

20030067792

Legislative and Regulatory Task Force Report: Penalties for Internet Attacks and Cyber Crime

Feb. 2003; 30 pp.

Report No.(s): PB2003-106128; No Copyright; Avail: CASI; A03, Hardcopy

Protecting the USA cyber networks, one of its key critical infrastructures, is vital to ensuring the security of the U.S. homeland. Government and industry have made steady efforts to heighten awareness and take action against cyber crimes, and these efforts are likely to continue. The Presidents National Security Telecommunications Advisory Committees (NSTAC) Legislative and Regulatory Task Force (LRTF) was tasked with identifying existing legal penalties for prosecuting those committing intentional and malicious attacks on the Internet. It then made recommendations about whether current penalties should be strengthened and/or whether additional penalties were needed. This report represents the NSTACs recommendations regarding cyber crime laws.

NTIS

Internets; Computer Information Security; Law (Jurisprudence); Regulations

20030067794

Vulnerabilities Task Force Report Concentration of Assets: Telecom Hotels

Feb. 12, 2003; 16 pp.

Report No.(s): PB2003-106132; No Copyright; Avail: CASI; A03, Hardcopy

The Administration has expressed concern that the concentration of multiple entities telecommunications assets in specific locations may have implications for the security and reliability of the telecommunications infrastructure. The Presidents National Security Telecommunications Advisory Committee (NSTAC) Industry Executive Subcommittee chartered the Vulnerabilities Task Force (VTF) to examine these issues. This report addresses the Administrations concerns about the concentration of telecommunications assets in telecom hotels.

NTIS

Industries; Telecommunication; Vulnerability; Communication Networks

20030067795

Vulnerabilities Task Force Report Trusted Access

Jan. 27, 2003; 20 pp.

Report No.(s): PB2003-106134; No Copyright; Avail: CASI; A03, Hardcopy

The Administration has expressed concern that the concentration of multiple entities telecommunications assets in specific locations may have implications for the security and reliability of the telecommunications infrastructure. During the business and executive sessions of the National Security Telecommunications Advisory Committee (NSTAC) XXV meeting, concerns focused on telecom hotels, Internet peering points, trusted access to telecommunications facilities, equipment chain of control issues, and cable landings. Each of the security issues will be addressed in separate VTF reports. A final executive summary document will be created to highlight each topic and NSTAC recommendation. This report addresses the Administrations concerns that the telecommunications infrastructure may be more vulnerable because trusted physical access (hereafter

referred to as 'access') is granted to individuals requiring entrance to sites where telecommunications assets are concentrated.
NTIS
Internets; Telecommunication; Computer Information Security; Research And Development

20030068008 Wisconsin Univ., Milwaukee, WI, USA, Wisconsin Univ., Madison, WI, USA
Long Range Deployment of ITS Strategies: Concept Definition
Horowitz, A. J.; Duarte, J.; Cross, A.; Feb. 2003; 114 pp.; In English
Report No.(s): PB2003-103774; No Copyright; Avail: CASI; A06, Hardcopy

A considerable amount of effort in the past has been devoted to developing methodologies for short-range ITS deployment. This report deals with the issue of how ITS (Intelligent Transportation Systems) strategies and technologies should be implemented over a long period of time (10 to 20 years). This report addresses the following questions: Are there many ITS strategies that have long-range implications and, if so, which of the strategies has greatest relevance. Is there a consensus as to the best way of performing strategic ITS deployment planning. What features of strategic ITS planning should be retained for long-range ITS planning. What is the status of software tools for investigating the efforts of ITS deployment over the long-range. Can existing software tools be successfully used in long-range ITS deployment planning. How can those software tools be improved to provide better evaluations of ITS deployment plans. What are the obstacles. Can a workable methodology for long-range ITS deployment planning be demonstrated. What conclusions can be reached about long-range ITS deployment planning.
NTIS
Transportation; Computer Programs

20030068017 Army Aeromedical Research Lab., Fort Rucker, AL
Analysis of Head Motion in Rotary-Wing Flight Using Various Helmet-Mounted Display Configurations (Part II. Elevation)
Rostad, Ryan J.; Rash, Clarence E.; Crowley, John S.; May 2003; 151 pp.; In English
Report No.(s): AD-A414825; USAARL-2003-09; No Copyright; Avail: CASI; A08, Hardcopy

In spite of an immense increase in interest in helmet-mounted displays (HMDs) over the past two decades, there have been few studies on head motion while using HMDs in operational flight. Rotary-wing flights conducted using a number of HMD configurations have resulted in a head position database that will be useful in filling this void. Various analysis techniques have been applied to investigate characteristics of elevation head position distributions for a slalom flight maneuver for four visual environments good visual environment (daytime, unaided), night vision goggles, HMD with thermal imagery, and HMD with thermal imagery and symbology.
DTIC
Elevation; Helmet Mounted Displays; Rotary Wing Aircraft; Head (Anatomy); Rotary Wings

20030068020 Naval Postgraduate School, Monterey, CA
Evaluation of Secure 802.1X Port-Based Network Access Authentication Over 802.11 Wireless Local Area Networks
Ozturk, Huseyin S.; Mar. 2003; 191 pp.; In English; Original contains color illustrations
Report No.(s): AD-A415020; No Copyright; Avail: CASI; A09, Hardcopy

Since wireless technology has been used in Local Area Networks (LAN), our networks are easier to build and are more scalable and mobile than legacy structures. While providing these functionalities, Wireless LAN (WLAN)'s have some security vulnerabilities that should be addressed. Failing to examine the security risks of WLAN technology and to take the necessary countermeasures may result in unauthorized entry into the legacy local area networks and other attacks. A secure connection to an intranet, which holds critical data and applications, must be the utmost consideration in the effort to protect critical resources. This thesis builds an open-source test-bed for evaluating WLAN security protocols. Moreover, it investigates the suitability of the IEEE 802.1X standard to provide the required security framework to WLANs. This research determines that the IEEE 802. 1X could enhance the security level in authentication and privacy by enabling the rekeying process but would not prevent Denial of Service attacks via unauthenticated management frames.
DTIC
Local Area Networks; Evaluation; Computer Networks; Communication Networks; Computer Information Security

20030068163 Swedish Defence Research Establishment, Stockholm, Sweden
Retroreflective Free-space Optical Communication: System Analysis and Performance
Sjoeqvist, L.; Hard, S.; Junique, S.; Noharet, B.; Rudquist, P.; Nov. 2001; 74 pp.; In English
Report No.(s): PB2003-104351; FOI-R-0344-SE; No Copyright; Avail: CASI; A04, Hardcopy

Free-space optical communication shows several interesting features for military applications such as transfer of large data quantities, covert data transfer, low jamming risk and overhearing, small volume and low weight etc. In retroreflective free-space optical communication a passive receiver is used to intensity modulate light and transfer data to a transceiver unit. The transceiver unit can be implemented with a non-mechanical beam steering feature for link establishment, tracking and signal optimization. The retromodulating receiver can use multiple quantum well modulators to optically modulate the intensity of the light. This report describes a system analysis of a retromodulating free-space optical communication system using MQW modulators for the retroreflecting receiver and non-mechanical beam steering using liquid crystal spatial light modulators. Different system designs and technology are reviewed and discussed. Performance calculations including effects from atmospheric attenuation, turbulence and diffraction have been carried out. Problems related to the atmospheric effect and different designs of the retroreflecting receiver are emphasized.
NTIS
Optical Communication; Systems Analysis; Reflectance

20030068336 General Accounting Office, Washington, DC
US International Broadcasting: New Strategic Approach Focuses on Reaching Large Audiences but Lacks Measurable Program Objectives
Jul. 2003; 60 pp.; In English
Report No.(s): PB2003-106621; GAO-03-772; No Copyright; Avail: CASI; A04, Hardcopy

Prompted by a desire to reverse declining audience trends and to support the war on terrorism, the Broadcasting Board of Governors (BBG), the agency responsible for U.S. international broadcasting, began developing its new strategic approach to international broadcasting in July 2001. This approach emphasizes the need to reach mass audiences by applying modern broadcast techniques and strategically allocating resources to focus on high-priority markets. GAO was asked to examine (1) whether recent program initiatives have adhered to the Board's new strategic approach to broadcasting, (2) how the approach's effectiveness will be assessed, and (3) what critical challenges the Board faces in executing its strategy and how these challenges will be addressed.
NTIS
Broadcasting; Market Research

20030068389 Newcastle-upon-Tyne Univ., Newcastle
First Specification of APLs and Protocols for the MAFTIA Middleware
Welch, I.; Armstrong, J. M.; Cachin, C.; Correia, M.; Costes, A.; Sep. 2002; 110 pp.
Report No.(s): PB2003-105214; CS-TR-738; Copyright; Avail: National Technical Information Service (NTIS)

This document describes the First specification of the APIs and Protocols for the MAFTIA Middleware. The architecture of the middleware subsystem has been described in a previous document where the several modules and services were introduced: Activity Services; Communication Services; Network Abstraction; Trusted and Untrusted Components. The purpose of the present document is to make concrete the functionality of the middleware components, by defining their application programming interfaces, and describing the protocols implementing the above-mentioned functionality.
NTIS
Architecture (Computers); Modules; Telecommunication

20030068390 National Telecommunications and Information Administration, Washington, DC
Measurements to Determine Potential Interference to Public Safety Radio Receivers from Ultrawideband Transmission Systems
Hoffman, J. R.; Haakinson, E. J.; Lo, Y.; Jun. 2003; 64 pp.
Report No.(s): PB2003-105784; NTIA-TR-03-402; No Copyright; Avail: CASI; A04, Hardcopy

This report describes laboratory measurements to determine the extent and nature of interference to Public Safety radio receivers by ultrawideband (UWB) signals. Two Public Safety radio receivers from different manufacturers were tested in the 138-MHz band, both configured for Project 25 digital radio mode and one additionally configured and tested in analog mode. The laboratory measurements were performed by inserting increasing levels of UWB interference and measuring either bit-error rate (BER) for digital radios or signal-plus-noise-plus-distortion to noise-plus-distortion ratio (SINAD) for one of the same radios placed in analog mode. By varying pulse repetition frequency (PRF), pulse spacing schemes, and gating, a variety

of UWB signals were simulated, which were either Gaussian noise-like, sinusoidal, or a hybrid of the two when passed through the receiver passband.
NTIS
Radio Receivers; Radio Communication

20030068391
Institute for Telecommunication Sciences: 2002 Technical Progress Report
Dec. 2002; In English
Report No.(s): PB2003-105889; No Copyright; Avail: National Technical Information Service (NTIS)
Contents include the following: Disclaimer; The ITS Mission; Overview; Spectrum and Propagation Measurements; Telecommunications and Information Technology Planning; Telecommunication Engineering, Analysis, and Modeling; Telecommunication Theory; Support to Private Sector Telecommunications Activities; ITS Tools and Facilities; ITS Projects in FY 2002; ITS Outputs in FY 2002; Abbreviations/Acronyms and Organization charts.
NTIS
Technological Forecasting; Telecommunication; Communication Satellites

20030068392
BMDO Fiber-Optic Technologies for Telecommunications. Part 2: Optical Switches and Circuity
Jun. 2001; 38 pp.; In English
Report No.(s): PB2003-105970; No Copyright; Avail: CASI; A03, Hardcopy
;Table of Contents: Introduction; Photonic switches; The hot market of optical-core photonic switches; Waveguides and opto-electronic circuitry and Optical circuitry keeps the pace.
NTIS
Fiber Optics; Telecommunication

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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*.

20030067707 National Information Display Lab., Princeton, NJ, USA
Evaluation of the Cornerstone p1750 22-Inch Diagonal Color CRT Monitor for Monoscopic and Stereoscopic Imagery
Dec. 20, 2001; 54 pp.; In English
Report No.(s): AD-A414676; No Copyright; Avail: CASI; A04, Hardcopy
Color monitors are more difficult to evaluate and their performance may not compare to monochrome monitors. Color monitors have three electron guns (k, G, and B) to focus and converge. They also have a perforated steel shadow mask that separates the colors on the screen and this adds complexity. Color lines formed on the phosphor screen may not be as narrow as for a monochrome, single electron gun-formed spot. The color monitor's light output may not be as high. The IEC monitor specifications for color monitors reflect this difference, and have lower luminance and stereo extinction ratio requirements than a monochrome monitor. In spite of these limitations, Imagery and Geospatial Analysts at a number of sites may do all their analyses on color monitors.
DTIC
Images; Monitors; Cathode Ray Tubes

20030067749 Boston Univ., Boston, MA
Ultraviolet-spectrum Light-emitting Diodes with Omnidirectional Reflectors for High Extraction Efficiency
Schubert, E. F.; Feb. 10, 2003; 4 pp.; In English
Contract(s)/Grant(s): DAAD19-02-1-0320
Report No.(s): AD-A414747; No Copyright; Avail: CASI; A01, Hardcopy
This report covers the period August 1st to August 31st 2002 while I was working for Boston University (BU). On September 1st I transferred to Rensselaer Polytechnic Institute (RPI). It is my understanding that this report is required for the transfer of the contract from BU to RPI. The reflective properties of a triple-layer omni-directional reflector have been

investigated. The reflector has a two-fold purpose namely it serves as ohmic contact to the top GaN layer of a UV LED and also as a reflector. The reflector consists of the semiconductor (GaN), indium tin oxide (ITO) and a metal layer. It was found that the reflector has reflectivities exceeding 90% for all angles of incidence. Such highly reflective ohmic contacts are desirable as conventional ohmic contacts represent a major loss mechanism in UV LEDs.
DTIC
Light Emitting Diodes; Reflectance

20030067766 Newcastle-upon-Tyne Univ., Newcastle
Visualisation of Coding in Asynchronous Circuit Design
Madalinski, A.; Bystrov, A.; Yakovlev, A.; Feb. 2003; 22 pp.; In English
Report No.(s): PB2003-105181; CS-TR-768; Copyright; Avail: National Technical Information Service (NTIS)

Synthesis of asynchronous circuits from Signal Transition Graphs (STGs) involves solving state coding conflicts. The refinement process is generally done automatically using heuristics and can often produce a sub-optimal solution, which has to be corrected manually by the designer. This paper presents a framework for an interactive refinement process aimed to help the designer. Rather than using actual conflicts, the process is based on the visualization of conflict cores. Cores are sets of transitions causing state coding conflicts, which are represented at the level of a finite complete prefix (unfolding) of STGs.
NTIS
Circuits; Coding; Synchronism; Scientific Visualization; Synthesis

20030067783 Newcastle-upon-Tyne Univ., Newcastle
Detecting State Coding Conflicts in STG Unfoldings Using SAT
Khomenko, V.; Koutny, M.; Yakovlev, A.; Jan. 2003; 28 pp.
Report No.(s): PB2003-105187; CS-TR-778; Copyright; Avail: National Technical Information Service (NTIS)

The behavior of asynchronous circuits is often described by Signal Transition Graphs (STGs), which are Petri nets whose transitions are interpreted as rising and falling edges of signals. One of the crucial problems in the synthesis of such circuits is that of identifying whether an STG satisfies the Complete State Coding (CSC), Unique State Coding (USC), or normalcy (a necessary condition for their implementability using gates without input invertors) requirements, e.g. by using model checking based on the reachability graph of an STG. In this paper, the authors avoid constructing the reachability graph of an STG, which can lead to state space explosion, and instead use only the information about causality and structural conflicts between the events involved in a finite and complete prefix of its unfolding. The model checking algorithm is derived by adopting the Boolean Satisfiability (SAT) approach. Following the basic formulation of the state coding conflict relationship, the authors present some problem-specific optimization rules. This technique leads not only to huge memory savings when compared to the CSC/USC/ normalcy violation detection methods based on reachability graphs, but CSC/USC/normalcy violation detection methods based on reachability graphs, but also to significant speedups in many cases.
NTIS
Algorithms; Coding; Detection; Graphs (Charts); Synchronism

20030067822 NASA Marshall Space Flight Center, Huntsville, AL, USA
Macromolecular Topography Leaps into the Digital Age
Lovelace, J.; Bellamy, H.; Snell, E. H.; Borgstahl, G.; [2003]; 1 pp.; In English; American Crystallographic Association Conference, 26-31 Jul. 2003, Covington, KY, USA
Contract(s)/Grant(s): NCC8-66; No Copyright; Avail: Other Sources; Abstract Only

A low-cost, real-time digital topography system is under development which will replace x-ray film and nuclear emulsion plates. The imaging system is based on an inexpensive surveillance camera that offers a 1000x1000 array of 8 im square pixels, anti-blooming circuitry, and very quick read out. Currently, the system directly converts x-rays to an image with no phosphor. The system is small and light and can be easily adapted to work with other crystallographic equipment. Preliminary images have been acquired of cubic insulin at the NSLS x26c beam line. NSLS x26c was configured for unfocused monochromatic radiation. Six reflections were collected with stills spaced from 0.002 to 0.001 degrees apart across the entire oscillation range that the reflections were in diffracting condition. All of the reflections were rotated to the vertical to reduce Lorentz and beam related effects. This particular CCD is designed for short exposure applications (much less than 1 sec) and so has a relatively high dark current leading to noisy raw images. The images are processed to remove background and other system noise with a multi-step approach including the use of wavelets, histogram, and mean window filtering. After processing, animations were constructed with the corresponding reflection profile to show the diffraction of the crystal volume vs. the oscillation angle as

well as composite images showing the parts of the crystal with the strongest diffraction for each reflection. The final goal is to correlate features seen in reflection profiles captured with fine phi slicing to those seen in the topography images. With this development macromolecular topography finally comes into the digital age.
Author
Digital Systems; Topography; Macromolecules; Imaging Techniques

20030067826 Naval Postgraduate School, Monterey, CA
Prototype Fabrication and Measurements of Uplink and Downlink Microstrip Patch Antennas for NPSAT-1
Goekben, Ilhan; Mar. 2003; 71 pp.; In English; Original contains color illustrations
Report No.(s): AD-A414803; No Copyright; Avail: CASI; A04, Hardcopy

This thesis addresses the prototyping, measurement and validation of two circularly polarized microstrip patch antennas designed by LTJG Mahmut Erel for the NP SAT-1. The antenna system (receive and transmit), consisting of two antennas on a ground plane and their feed systems, was field-tested. The results were compared to the CSTGR) Microwave Studio(trademark) Finite Difference Time Domain (FDTD) software package predictions in order to verify that this design satisfies the NP SAT-1 requirements for bandwidth, free-space radiation pattern and low-profile shape.
DTIC
Antennas; Antenna Radiation Patterns; Antenna Design

20030067899 NASA Ames Research Center, Moffett Field, CA, USA
Using Temporal Fill Factor to Reduce Frame Reconstruction Rates
Larimer, James; Balram, Nikhil; Gille, Jennifer; Luszcz, Jeffery; August 06, 1997; 3 pp.; In English
Contract(s)/Grant(s): NAS2-98080; DTFA01-88-Z-02015; Copyright; Avail: CASI; A01, Hardcopy

The newer active matrix display technologies such as TFT-LCD, DMD, PDP maintain their pixel values through the entire frame time, presenting a 100% temporal fill factor, in contrast to the duty cycle produced by the phosphor impulse response of the CRT. This sample-and-hold characteristic can be exploited to lower the displayed frame rate without affecting visual quality. The lower frame rate results in significantly lower transmission bandwidth, power, and cost.
Author
Bandwidth; Display Devices; Image Resolution

20030067982 NAVAL POSTGRADUATE SCHOOL MONTEREY CA, Monterey, CA, USA
Reduction of Mutual Coupling in Small Dipole Array Antennas
Hock, Chua E.; Mar. 2003; 143 pp.; In English; Original contains color illustrations
Report No.(s): AD-A414844; No Copyright; Avail: CASI; A07, Hardcopy

The mutual coupling in phased array is a well-known phenomenon. It affects the active element pattern of the array as the phase of the individual element is altered. In an array that has many elements, the effect is identical for all the elements that are nearer to the center of the antenna, thus allowing a more predictable scan performance with respect to the phase of the elements. However, in a small array that has only three elements, the active element pattern for the elements at the end can be significantly different from the center element and this affects the predictability of operations such as direction finding. The thesis investigates two ways that can potentially reduce or at least control the mutual coupling in small arrays. The first method simply adds a dummy element with a special load condition to each end of the array to make the edge element 'feel' as if there are more elements next to it. The second method uses a passive feedback circuit to both monitor and correct the magnitude and phase of the mutual coupling at the input of each array element. A hybrid ring is attached to each of the elements to monitor the amount of interference received by that element. Simulation results for the dummy element method shows that some reduction in phase error can be achieved if the spacing and length of the element are selected properly. The compensation network approach relies on an efficient two-port array element. The research has focused on the design of a two-port printed circuit dipole that could be used in such an array. The dipole was designed, simulated, and fabricated. Future research will use this element in a compensation network.
DTIC
Antenna Arrays; Dipole Antennas; Phased Arrays

20030067993 Materials Research Society, Warrendale, PA
Symposium H: 3-D Nanoengineered Assemblies
Taylor, David P.; Ikuta, Koji; Merhari, Lhadi; Orlando, Thomas; Dec. 2002; 24 pp.; In English
Contract(s)/Grant(s): F49620-03-1-0106
Report No.(s): AD-A414853; AFRL-SR-AR-TR-03-0200; No Copyright; Avail: CASI; A03, Hardcopy

The 3D Nanoengineered Assemblies symposium brought together researchers from a wide range of fields. 3D Nanoengineered Assemblies included much work that was 'not quite truly 3D' and 'not quite on the nanoscale.' The result was a meeting in which common overarching themes emerged from presentations in widely separated research areas. More than 100 abstracts were submitted, and there were 29 invited talks covering work that spanned a remarkable number of topics. One of the most interesting aspects of nanotechnology is the ability to access physical phenomena that occur on the nanoscale. A compelling example of this sort of nanoscale phenomena exploits the collective electronic excitations (plasma oscillations or plasmons) in metal nanoparticles to manipulate energy and matter. Lithographic methods can be either masked based or maskless. Much of the time devoted to modern materials processing has been spent developing mask based lithographic techniques and as a consequence they are quite mature. Some of the speakers presented work that used conventional methods at high resolution to great advantage. The maskless direct write processing community was well represented by electron and particle beam talks. Non-lithographic techniques were also discussed in this meeting. This included a number of talks on self-assembly. Nanoparticle assemblies, Nanotubes, Nanowires and Nanosprings were the topics of a number of talks. Two of the aspects of the biological model for materials processing that make it most appealing are the directed self-assembly and the bottom-up approach to processing. Together, these aspects of biological control of materials have become a prototype for an elegant approach to processing.
DTIC
Lithography; Nanotechnology; Nanoparticles

20030068009 Swedish Defence Research Establishment, Tumba
Design and Calibration of a Capacitive Voltage Probe for use in the TTHPM System
Appelgren, P.; Hultman, T.; Larsson, A.; Nyholm, S. E.; Mar. 2002; In English
Report No.(s): PB2003-103259; FOI-R-0428-SE; No Copyright; Avail: National Technical Information Service (NTIS)
This technical report describes design and calibration of high voltage capacitive voltage probe to be used in the TTHPM system. The probe is designed to measure voltages of several hundreds of kilovolts and has a sensitivity of 1.425 kV/V. The output is in the order of hundreds of volts. A Le Croy high impedance probe is used to monitor the output signal.
NTIS
Impedance Probes; High Voltages

20030068123 NASA Glenn Research Center, Cleveland, OH, USA
Update on International Space Station Nickel-Hydrogen Battery On-Orbit Performance
Dalton, Penni; Cohen, Fred; August 2003; 16 pp.; In English; First International energy Conversion Engineering Conference, 17-21 Aug. 2003, Portsmouth, VA, USA
Contract(s)/Grant(s): WBS 22-335-14-03
Report No.(s): NASA/TM-2003-212542; AIAA Paper 2003-6065; NAS 1.15:212542; E-14108; No Copyright; Avail: CASI; A03, Hardcopy
International Space Station (ISS) Electric Power System (EPS) utilizes Nickel-Hydrogen (Ni-H2) batteries as part of its power system to store electrical energy. The batteries are charged during insolation and discharged during eclipse. The batteries are designed to operate at a 35% depth of discharge (DOD) maximum during normal operation. Thirty-eight individual pressure vessel (IPV) Ni-H2 battery cells are series-connected and packaged in an Orbital Replacement Unit (ORU). Two ORUs are series-connected utilizing a total of 76 cells, to form one battery. The ISS is the first application for low earth orbit (LEO) cycling of this quantity of series-connected cells. The P6 (Port) Integrated Equipment Assembly (IEA) containing the initial ISS high-power components was successfully launched on November 30, 2000. The IEA contains 12 Battery Subassembly ORUs (6 batteries) that provide station power during eclipse periods. This paper will discuss the battery performance data after two and a half years of cycling.
Author
Nickel Hydrogen Batteries; International Space Station; Space Station Power Supplies; Performance Prediction

20030068290 Swedish Defence Research Establishment, Tumba
Design and Calibration of Rogowski Current Probes
Nyholm, S. E.; Appelgren, P.; Hurtig, T.; Hultman, T.; Mar. 2002; In English
Report No.(s): PB2003-103260; FOI-R-0427-SE; No Copyright; Avail: National Technical Information Service (NTIS)
Rogowski current probes are used for contact free measurement of non-stationary or transient very high currents. Most often a Rogowski probe must be specially designed for the particular measurement situation at hand. This includes the

selection of sensitivity and frequency bandwidth. However careful the probe design is undertaken the probe still has to be calibrated against a known current. This report describes the basic theory of Rogowski probes, some practical design considerations and gives as examples two probes designed for current measurement at different places in a laboratory high voltage generating equipment used. An equipment constructed for calibration of fast probes is also described. The report constitutes a partial documentation of the measurement technology used in experiments conducted within the FOI research project on HPM weapons technology. The purpose of the report is to give a fundamental understanding of the Rogowski probe concept, document our design and constitute a basis for the construction of new Rogowski probes, adapted to measurement situations with differing demands.
NTIS
Calibrating; High Voltages

20030068291 Swedish Defence Research Establishment, Linkoeping
Status Report - Project Optical Signatures - March 2002
Nelsson, C.; Mar. 2002; In Swedish
Report No.(s): PB2003-104303; FOI-R-0453-SE; No Copyright; Avail: National Technical Information Service (NTIS)
This report summarizes the activities in the project Optical Signatures during the year 2001 and the first quarter of 2002. Also presented is the plan for the remaining of 2002. The project is organized in three parts: Background signatures; Targets in background; Atmospheric effects.
NTIS
Atmospheric Effects; Signatures; Targets

20030068328 Newcastle-upon-Tyne Univ., Newcastle
Asynchronous Circuit Synthesis by Direct Mapping: Interfacing to Envrionment
Bystrov, A.; Yakovlev, A.; Sep. 2002; 28 pp.
Report No.(s): PB2003-105197; CS-TR-743; Copyright; Avail: National Technical Information Service (NTIS)
Direct mapping helps avoid algorithmic complexity which is inherent in logic synthesis methods. However, existing techniques for direct mapping of Petri net specifications to asynchronous control circuit do not deliver in performance due to logic overhead and inefficient interface to the environment. The paper presents a direct mapping method for Signal Transition Graphs (STGs) targeted at lower latency between input and output events. It is based on two behavior-preserving transformations applied to the initial STG model: output exposition and environment tracking. The former allows interface signals to be generated concurrently to internal transitions. The latter prevents creation of coding conflicts. Subsequent refinement combines the use of the tracking and input signals in the control of the output flip-flops so as to optimize the circuit size by removing some tracking components. The depth of final logic in the design examples is one or two gates. The comparison to logic synthesis methods indicates lower output latency and modest size increase. The proposed direct-mapping method allows using fast transistor-level implementations for tracking and output signal with well-localized relative timing constraints.
NTIS
Algorithms; Circuits

20030068330 National Inst. of Standards and Technology, Gaithersburg, MD
Semiconductor Industry IT Needs: Lessons Learned from Across the Engineering Chain
Li, Y. S.; Goldstein, B.; Jun. 2003; 20 pp.
Report No.(s): PB2003-105810; NISTIR-7003; No Copyright; Avail: CASI; A03, Hardcopy
This paper presents information gathered during a series of site visits conducted by National Institute of Standards and Technology (NIST) staff between December 2001 and July 2002. A total of six companies were visited including: four Integrated Device Manufacturers (IDMs); one Photomask Supplier; and one Design Firm. The purpose of the site visits was to understand the impact of competitive and economic pressures on current IT practice in the semiconductor industry, to identify industry IT standardization needs, and to contribute this assessment as guidance for federal research investments and as input to industry roadmap efforts.
NTIS
Semiconductors (Materials); Photomasks

20030068422 Tulane Univ., New Orleans, LA, USA

Point to Point Control of the Hydrogen Mixer

Barbieri, Enrique; Richter, Hanz; Figueroa, Fernando; July 02, 2003; 17 pp.; In English

Report No.(s): SE-2003-06-0043-SSC; No Copyright; Avail: CASI; A03, Hardcopy

We continue to build on the theoretical modelling of a liquid hydrogen (LH2) and gas hydrogen (GH2) mixer subsystem. The mixer described in this work is responsible for combining high pressure LH2 and GH2 to produce a hydrogen flow that meets certain thermodynamic properties. The desired properties are maintained by precise control of the LH2 and GH2 flows. The mixer is modelled as a general multi-flow lumped volume for single constituent fluids using density and internal energy as states. The set of nonlinear differential equations is modelled in the SIMULINK environment including a table look-up feature of the fluid thermodynamic properties. A small signal (linear) model is developed based on the nonlinear model and simulated as well. Pulse disturbances are introduced to the valve positions and the quality of the linear model is ascertained by comparing its behavior against the nonlinear model simulations. Valve control strategies that simulate an operator-in-the-loop scenario are then explored demonstrating the need for automatic feedback control. Finally, optimal single-output and multi-output Proportional/Integral controllers are designed based on the linear model and applied to the nonlinear model with excellent results to track simultaneous, constant setpoint changes in desired exit flow, exit temperature, and mixer pressure, as well as to reject unmeasureable but bounded additive step perturbations in the valve positions.

Author

Liquid Hydrogen; Mathematical Models; Liquid-Gas Mixtures; Thermodynamics; Automatic Control; Mixers

20030068532 Hiroshima Prefectural Agriculture Research Center, Hiroshima, Japan

Piezoresistive Property of CVD Diamond Films

Yamamoto, Akira; Tsutsumoto, Takahiro; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 255-258; In English; See also 20030068525; Original contains color illustrations; No Copyright; Avail: CASI; A01, Hardcopy

Piezoresistive properties of chemical vapor-deposited boron-doped p-type polycrystalline diamond films were investigated. The p-type polycrystalline diamond films of about 2 m thickness were grown on SiO2/Si substrate using a hot-filament reactor. Effective carbon concentration, defined as (C-O)/H, was varied from 2.2 to 5.5 %, and boron to carbon ratio was kept constant. Gauge factor for the p-type diamond piezoresister decreased with carbon to hydrogen ratio. The quality of the diamond films were examined by using a scanning electron microscope (SEM), Raman spectroscopy and X-ray diffraction. The diamond films were degraded with the (C-O)/H.

Author

Doped Crystals; Diamond Films; Boron; Vapor Deposition; Polycrystals

20030068536 Case Western Reserve Univ., Cleveland, OH, USA, Case Western Reserve Univ., Cleveland, OH, USA

Co-Doping of Diamond with Boron and Sulfur

Eaton, Sally C.; Anderson, Alfred B.; Angus, John C.; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 527-532; In English; See also 20030068525

Contract(s)/Grant(s): NSF CHE-98-16345; CRDF-RC1-2053; No Copyright; Avail: CASI; A02, Hardcopy

Characterization of diamond co-doped with boron and sulfur is reported. SIMS analysis shows that the sulfur is concentrated in the near surface region, although increased concentrations of sulfur above background levels appear in the bulk diamond as well. Hall effect and thermoelectric power measurements indicate that the conductivity is n-type in the surface region and can be either n- or p-type in the bulk, depending on the degree of compensation with boron. The co-doped samples are not stable at elevated temperatures and there is an irreversible loss of conductivity when heated above 400 K in air. Electrochemical polarization of the n-type diamond showed blocking at anodic potentials up to +5 V versus the saturated calomel electrode. Two types of p/n junctions using the n-type boron/sulfur co-doped diamond were made: one using boron-doped diamond as the p-type side and the other using the p-type surface conductivity induced by hydrogen termination. The turn-on voltage in both junctions was approximately 0.5 V, which suggests that the Fermi level in the n-type diamond is low in the band gap. The n-type conductivity likely arises from an impurity band. The nature of the centers giving rise to the conductivity is not known.

Author

Boron; Diamond Films; Doped Crystals; Sulfur; Thermoelectricity

20030068542 National Tsing Hua Univ., Hsinchu, Taiwan, Province of China

Characteristics of Carbon Nanotube Electron Field Emission Devices Prepared by LTCC Process

Tsai, Tsong-Yen; Tai, Nyan-Hwa; Lin, I-Nan; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 88; In English; See also 20030068525; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

Carbon nanotubes (CNT) possess marvelous electron field emission properties and have been widely investigated for applications as electron sources in field emission displays (FED). While the high quality carbon nanotubes can be synthesized by several methods, including laser ablation, thermal chemical vapor deposition and plasma enhanced chemical vapor deposition techniques, direct growth of CNT on electron field emission devices is still very difficult due to stringent control of synthesizing conditions necessary. Screen-printing of CNT/Ag-paste on glass substrates is an inexpensive and efficient way of making large patterned emitter arrays, but suffered from the packaging and electrical connecting problems. In contrast, low temperature cofirable ceramics (LTCC), which provide mutilayer inter-connection and hermit seal at the same time, are thus suitable for using as substrate materials for electron emitters. In this paper, we shall demonstrate the electron field emitters using CNT printed on LTCC as electron sources.

Author

Carbon Nanotubes; Electron Emission; Field Emission; Nanofabrication; Low Temperature; Ceramics

20030068546 Ulm Univ., Germany

Bi-Stable Thermal Microactuators Based on CVD Diamond

Mueller, R.; Schmid, P.; Munding, A.; Hernandez-Gullien, F. J.; Kohn, E.; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 136-140; In English; See also 20030068525; Original contains black and white illustrations; No Copyright; Avail: CASI; A01, Hardcopy

In this work, two examples of thermally driven MEMS devices based on polycrystalline diamond films are presented. These are a bi-stable diamond microswitch and a diamond micropump. By employing the classical bimetal effect and using diamond as a multi-purpose material (i.e. mechanical carrier, heater element, bi-metal element) the device layout can be rather simple. Device working principles, layouts, technology and first results on device operation are given.

Author

Actuators; Microelectromechanical Systems; Diamond Films; Microinstrumentation

20030068547 Ulm Univ., Germany

Microwave Power Performance of Diamond Surface-Channel FETS Using High-Quality Homoepitaxial Layers

Kasu, M.; Kubovic, M.; Aleksov, A.; Kallfass, I.; Spitzberg, U.; Kobayashi, N.; Makimoto, T.; Schumacher, H.; Kohn, E.; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 159-162; In English; See also 20030068525; Original contains color illustrations; No Copyright; Avail: CASI; A01, Hardcopy

High-quality homoepitaxial diamond layers were used to fabricate surface-channel short-gate FETs. RF measurements of FETs with 0.2-microns-long gate yielded f(sub T) of 20 GHz, fmaxMAG of 50 GHz, f(sub maxU) of 58 GHz. FETs with 0.4-microns-long gate exhibited a maximum output power level (P(sub out)) at 1 GHz of 0.35 W/mm.

Author

Radio Frequencies; Microwaves; Superhigh Frequencies

20030068553 Chongqing Univ., China

Theoretical Analysis on Piezoresistive Effect of Diamond Films by Chemical Vapor Deposition

Liao, K. J.; Wang, W. L.; Kong, C. Y.; Wang, S. X.; Feng, Q.; Ma, Y.; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 260-265; In English; See also 20030068525

Contract(s)/Grant(s): NNSFC-50005027; No Copyright; Avail: CASI; A02, Hardcopy

The piezoresistive effect in p-type heteroepitaxial diamond films was investigated. The diamond films were prepared on Si (100) by microwave plasma chemical vapor deposition. The films were boron doped by the cold implantation and rapid annealing technique. The experimental results showed that the gauge factor for the diamond films at 100 microstrain was about 1200 at room temperature. Based on the Fuchs and Sondheimer thin film theory and valence band split-off model, a theoretical calculation of the piezoresistive effect in diamond films was presented by Solving Boltzmanm transport equation in the

relaxation time approximation and using the parallel connection resistance model. The analysis results were in good agreement with the experimental data.
Author
Diamond Films; Vapor Deposition; Doped Crystals; Boron

20030068585 NASA Ames Research Center, Moffett Field, CA, USA
Carbon Nanotube Electrode Arrays For Enhanced Chemical and Biological Sensing
Han, Jie; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 17; In English; See also 20030068525; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

Applications of carbon nanotubes for ultra-sensitive electrical sensing of chemical and biological species have been a major focus in NASA Ames Center for Nanotechnology. Great progress has been made toward controlled growth and chemical functionalization of vertically aligned carbon nanotube arrays and integration into micro-fabricated chip devices. Carbon nanotube electrode arrays devices have been used for sub-attomole detection of DNA molecules. Interdigitated carbon nanotubes arrays devices have been applied to sub ppb (part per billion) level chemical sensing for many molecules at room temperature. Stability and reliability have also been addressed in our device development. These results show order of magnitude improvement in device performance, size and power consumption as compared to micro devices, promising applications of carbon nanotube electrode arrays for clinical molecular diagnostics, personal medical testing and monitoring, and environmental monitoring.
Author
Carbon Nanotubes; Electrodes; Nanotechnology

20030068586 Cambridge Univ., Cambridge, UK
Growth and Characterisation of Multiwall Carbon Nanotubes/Fibres for Field Emission Applications
Milne, W. I.; Teo, K. B. K.; Lacerda, R.; Chhowalla, M.; Amaratunga, G. A. J.; Hasko, D. G.; Lee, S.-B.; Legagneux, P.; Pribat, D.; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 18; In English; See also 20030068525; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

Carbon Nanotubes have generated an increasing amount of interest since their initial observation by Ijima in 1991. Recently numerous groups have demonstrated both the lateral and vertical growth of carbon nanotube/fibres (CNTs) with a high degree of control over their alignment, length and diameter using catalytically mediated Plasma Enhanced Chemical Vapour Deposition (PECVD). CNTs have thus emerged as highly promising candidates for use as electron field emitters in such applications as scanning probes, x-ray sources, flat panel displays, microwave amplifiers and parallel e-beam lithography systems. This paper will review the work that we've carried out using such a technique, employing Ni as the catalyst, to produce arrays of multiwall CNTs. The electrical properties of individual tubes will be described and the microscopic characterisation and field emission from such tubes will also be reported.
Author
Carbon Nanotubes; Vapor Deposition; Nanostructure Growth; Field Emission

20030068604 Moscow State Univ., Russia
Carbon Nano-Materials for Vacuum Electronics
Obraztsov, A. N.; Volkov, A. P.; Zakhidov, A. A.; Zolotukhin, A. A.; Ustinov, A. O.; Lyshenko, D. A.; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 89; In English; See also 20030068525; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

A number of vacuum electronic devices, including MW generators and amplifiers, CRT, X-ray tubes etc., utilize electron beams produced by cathode. An essential improvement of the devices may be obtained using field emission cathodes providing intense monoenergetic electron beam and operating at room temperature. Material of these cold cathodes must sustain very strong electric field and residual gas ion bombardment in the vacuum tubes. This requirement limits list of appropriate materials by a few hard metals (like Mo, W), semiconductors (Si) and carbons with diamond and graphite atomic configurations. The carbon materials have strongest interactomic sigma-sigma bonding but diamond has no free electrons to emit them into vacuum and graphite itself has layered structure with very weak interlayer bonding. Carbon nanotubes seems to be ideal field emitters having strongest graphite-type interactomic bonding cylindrical configuration of atomic layers, preventing their destruction under strong electric field and highest aspect ratios allowing significant decrease of used voltages.

This report presents our comparative study of field emission from various carbon nano-materials. Carbon nanotubes synthesized by arc-discharge methods, nano-diamond powders and films, and nano-graphitic CVD films were tested for field emission and other properties. The conditions of used CVD process were optimized to obtain most efficient carbon cold cathode material. We propose mechanism of electron emission from carbon nano- materials based on assumption of heterogeneous sp2-sp3 structure formation. Device applicability of the cold carbon cathodes is demonstrated in prototypes of cathodoluminescent light sources.
Author
Carbon Nanotubes; Electronics; Vapor Deposition; Field Emission; Cold Cathodes

20030068607 Uppsala Univ., Uppsala, Sweden
Applications of Single Crystal CVD Diamond
Twitchen, Daniel J.; Scarsbrook, Geoffrey A.; Whitehead, Andrew J.; Wort, Chris; Coe, Steve E.; Isberg, Jan; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 111; In English; See also 20030068525; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

The desire for electronic devices with higher power throughput, wider frequency bandwidth and higher operational temperatures is driving research and development of new semiconductors. One such area of research is wide band gap materials. Diamond is extreme in this group of materials (which includes SiC, ZnO and GaN), having a direct band gap of 7.5 eV, an indirect gap of 5.5 eV and a room temperature thermal conductivity in excess of 2000 W/m/K. Diamond electronic devices, such as power diodes and highfrequency field effect transistors, are expected to deliver outstanding performance due to the material.s excellent intrinsic properties such as high carrier mobilities and high breakdown field. However, the development of diamond electronics has been hampered by several problems including a lack of shallow dopants, heteroepitaxy as a route to large area single crystal growth, low crystal quality and poor consistency of synthetic material. We will report recent results on the fabrication and characterization of device quality single crystal CVD diamond. These results show, not only that material can be fabricated with performance that matches the very best natural diamond, but also that key properties such as the mobility and lifetime of the carriers, far exceed expectations. It has been lack of material quality that has limited diamond.s progress in the past, making it a minority player against SiC and GaN. However, the figures of merit now demonstrated for diamond are so extreme that the material should be re-examined as an ideal material for the most demanding power electronics and switching applications.
Author
High Frequencies; Bandwidth; Crystal Growth; Crystals; Diamonds

20030068608 National Inst. of Advanced Industrial Science and Technology, Tsukuba, Japan
Excitonic Emission from High Quality Homoepitaxial Diamond Films
Watanabe, Hideyuki; Kanno, Shokichi; Okushi, Hideyo; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 109; In English; See also 20030068525; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

Recently, deep-ultraviolet (deep-UV) light emitting diodes (LEDs) based on diamond have been proposed using a free-exciton emission from diamond. Presently, it is well known that commercially available LEDs and laser diodes (LDs) are based on direct band-gap semiconductors such as GaAs and other III-V compound semiconductors. On the other hand, diamond is an indirect band-gap semiconductor. In order to realize commercially available deep-UV LEDs and LDs based on the free-excitons of the diamond, therefore, the nature of the indirect free-excitons from the diamond should have some advantages that overcome the handicap of the indirect band-gap. The excitons in high quality diamond crystal have a high binding energy (80 meV), excitonic emission can be observed even up to room temperature. We have successfully observed the strong deep-UV emission of 235 nm (ie., 5.27 eV) due to free-exciton at room temperature in cathodoluminescence (CL) spectra from homoepitaxial diamond films prepared by microwave plasma assisted chemical vapor deposition (CVD) using CH4 gas system. More recently, under the condition of the very low CH4 concentrations less than 0.05%, we have successfully grown homoepitaxial diamond films with atomically flat surface. In these films, we found that the free-exciton emission intensity not only becomes stronger than the previous one, but the excitonic emission intensity increases super-linearly with the electron bean current in the high excitation region above a threshold value at room temperature. The nonlinear effects strongly suggest that application of free-exciton emission of diamond to deep-UV LEDs is very promising. In this paper, we report detailed behaviors of the nonlinear effects in free-exciton emission of CVD diamond films studied by the CL measurements.
Author
Diamond Films; Excitons; Ultraviolet Radiation; Epitaxy; Cathodoluminescence; Electron Emission

20030068609 Tokyo Gas Co. Ltd., Japan

Diamond LED Utilizing Free Exciton Recombination Emission

Horiuchi, Kenji; Kawamura, Aki; Okajima, Yuichiro; Ide, Takuhiro; Ishikura, Takefumi; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 114; In English; See also 20030068525; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

Diamond free exciton (FE) recombination emission located around 235 nanometers in wavelength is expected to be highly efficient and a good candidate for deep UV LED. We previously reported that an external efficiency (eta (sub ext)) of 8 x 10(exp -5) was obtained at room temperature from a pn junction sample composed of a S-doped CVD layer and a B-doped synthesized substrate. But a peak intensity ratio of band-A to that of FE emission (r(sub A/FE)) was about 100. This undesired behavior seemed to be caused by lattice defects on the mechanically polished p-type substrate. In order to improve LED characteristics, a B-doped layer was grown on a B-doped substrate by MW-assisted CVD method at the following conditions; C/H atomic ratio 0.05%, B/C atomic ratio 50 ppm, temperature 875 C and thickness 0.8 microns. Atomic force microscope analysis showed that the averaged roughness (Ra) of the surface was reduced from 0.48 nm to 0.32 nm. Then S-doped CVD layer growth and device separation by reactive ion etching were done the same way as previous sample. A typical r(sub A/FE) of thus fabricated LED's was greatly suppressed to 0.5, which suggested a defect concentration reduction at the junction. Maximum eta (sub ext) of 2.7 x 10(exp -4) and maximum output power of FE emission of 17 micro Watts was obtained. Author

Diamonds; Excitons; Fabrication; Light Emitting Diodes; P-N Junctions; Recombination Reactions; Field Emission

20030068620 National Inst. of Advanced Industrial Science and Technology, Tohoku, Japan

Capacitance-Voltage-Frequency Characteristics of Ni/Diamond Schottky Diodes on Oxidized Boron-Doped Homoepitaxial Diamond Film

Chen, Y. G.; Ogura, M.; Okushi, H.; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 141-146; In English; See also 20030068525; No Copyright; Avail: CASI; A02, Hardcopy

The electrical properties of Ni/diamond Schottky diodes fabricated on oxidized boron-doped homoepitaxial diamond film have been studied in order to investigate the electrical behaviors of diamond-based electronic devices. The current-voltage (I-V) characteristics of the Ni-Schottky contacts to the boron-doped homoepitaxial diamond film show excellent rectification properties. The capacitance-voltage (C-V) features of the Ni/diamond Schottky diodes were characterized in the frequency range from 10(exp -3) Hz to 2 x 10(exp 5) Hz. The C-V measurements indicate that the space charge density (N(sub I)) and the diffusion potential (V(sub d)) values are about 6.5 x 10(exp 16)/cu cm and 1.25 V, respectively, and have weak frequency dependence in the range from 10(exp -3) Hz to 10(exp 4) Hz. The capacitance-frequency measurement at zero bias indicated that the degrading capacitance at high frequency (>10(exp 4) Hz) is primarily due to the high series resistance of the homoepitaxial diamond film. The sudden drop in capacitance with increasing forward bias (V(sub F)) observed in Ni/diamond Schottky diodes is an interesting feature which can be explained by the model proposed by A.J. Snell et al.
Author

High Frequencies; Capacitance-Voltage Characteristics; Frequency Distribution; Frequency Ranges; Diamond Films

20030068626 Tamagawa Univ., Tokyo, Japan

Hole Mobility in Boron-Doped Homoepitaxial CVD Diamond Thin Films

Tsukioka, Kunio; Ogawa, Hisashi; Okushi, Hideyo; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 147-151; In English; See also 20030068525; No Copyright; Avail: CASI; A01, Hardcopy

The electric conductivity and Hall effect of boron-doped homoepitaxial CVD diamond thin films have been measured in the temperature range from 150K to 900 K. The temperature dependence of Hall mobility is analyzed by using an iterative technique assuming the scattering by ionized impurities, acoustic deformation potential and nonpolar optical phonons. The acoustic deformation potential constant E(sub I), the coupling constant of nonpolar optical phonons D(sub npo) and the donor concentration N(sub D) are used as fitting parameters. We take into account the band nonparabolicity through the hyperbolic band model. The density of state mass m(sub d), the conduction mass m(sub c) and the nonparabolicity parameter alpha are estimated from a LAPW band calculation. The temperature dependence of hole concentration is also numerically analyzed on the basis of the electric neutrality and the hyperbolic band model with fitting parameters of the acceptor concentration N(sub A), the donor concentration N(sub D), and the acceptor ionization energy E(sub A). For all the samples, best fits between experimental and theoretical values are obtained when E(sub I) approx. 16.0 eV, D(sub npo) approx. 1.2 x 10(exp 12) eV/m

and E(sub A) approx. 0.365 eV. Some indications of the impurity conduction were seen in the low temperature range.
Author
Diamond Films; Thin Films; Hall Effect; Hole Mobility; Scattering; Impurities

20030068632 Shanghai Jiao Tong Univ., China
Preparation of Diamond Coated Electrodes and the Application to Wastewater Treatment
He, X. C.; Yang, X. Q.; Shen, H. S.; Li, R. B.; Wang, Y. L.; Jia, J. P.; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 153; In English; See also 20030068525; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

B-doped diamond coated electrodes were grown on silicon and graphite substrates respectively by hot filament chemical vapor deposition (HFCVD) method. Detailed researches have been done to check out the influence of the growth parameters on film structure, surface morphology as well as the electrical and electrochemical properties of CVD diamond films. The textile wastewater treatment with diamond electrodes had a remarkable execution. The simulative and actual textile wastewater treatment with B-doped diamond coated electrodes on Si substrate had a remarkable execution. After 2 hours, the COD of the simulative and actual wastewater was reduced by 82.14% and 86.28% respectively. And the chromaticity color of the simulative and actual wastewater was reduced by 99% and 60.45% respectively.
Author
Diamond Films; Electrodes; Electrical Properties; Doped Crystals; Coatings

20030068636 Japan Fine Ceramics Center, Japan
Field Emission Properties of Diamond Particles: Electron Injection Into the Conduction Band by Tunneling at Thin Insulating Interface Layer
Watanabe, Akihiko; Kitabatake, Makoto; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 154; In English; See also 20030068525; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

ABSTRACT Mechanisms of the field emission from diamond particles (DP) with an insulating layer between the DP and the electrode was studied. The SiO2 thin layer was formed on metal substrate, and then the DPs were dispersed by the spin-coat technique. The chemical vapor deposited diamond films were formed on the DP to obtain well-defined DP surfaces. Energy positions of Fermi level (E(sub F)), valence band maximum (E(sub VBM)) and conduction band minimum (E(sub CBM)) of the DP surface were measured by ultraviolet photoemission spectroscopy (UPS). UPS spectra suggested that the surface of these specimens exhibited negative electron affinity (NEA). The field emission electron spectroscopy (FEES) spectra were measured using a stainless-steel grid electrode placed <1mm above the specimen with an extraction voltage (V(sub ex)). The FEES spectra exhibit peaks, which show energy shift (V(sub s)) toward the lower energy below E(sub F) with increasing V(sub ex). Vs is considered to be derived by the field enhancement at the insulating layer. Intensity of the field emission current (Ife) shows close relation with the V(sub s). The linearity of the Fowler-Nordheim (F-N) plot between I(sub fe) and V(sub s) was observed while the relationship between Ife and V(sub ex) show ambiguous characteristics. These results suggest that the field emission from the DP is mainly affected by field enhancement at insulating layer (between the DP and the electrode) rather than that at diamond surface (between the DP and vacuum). This work was supported by the FCT Project, which was consigned to JFCC by NEDO.
Author
Diamond Films; Field Emission; Electron Spectroscopy; Negative Electron Affinity; Photoelectric Emission

20030068637 Yamanashi Univ., Kofu, Japan
Experimental Comparison of Diamond Coated Electrode with Related Materials in Atmospheric Bipolar Corona Discharge
Akitsu, Tetsuya; Iwamura, Kayoko; Hatta, Akimitsu; Takaishi, Shuji; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 155; In English; See also 20030068525; Original contains color and black and white illustrations; No Copyright; Avail: CASI; A01, Hardcopy

The plasma CVD diamond coating on tungsten needles have been studied aiming an application in the static charge eliminator, using the bipolar corona discharge at the atmospheric pressure. The surface of the tungsten needle was coated by diamond coating and ion emission, the neutralization time as well as the long term stability of the ion emission have been examined.
Author
Vapor Deposition; Diamonds; Metal Surfaces; Tungsten; Diamond Films

20030068638 Japan Fine Ceramics Center, Tsukuba, Japan

Characterization of the Contact Layer Formed by Ar Ion Implantation Into Homoepitaxial Diamond Film

Yoshida, H.; Suzuki, M.; Sakuma, N.; Sakai, T.; Ogura, M.; Yamamoto, K.; Okushi, H.; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 163; In English; See also 20030068525; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

In this study, we characterized the contact layer formed by Ar ion implantation into homoepitaxial diamond films by applying X-ray photoelectron spectroscopy (XPS), and determined specific contact resistances between the layers and pad metal by the transmission line model (TLM) techniques for the first time. The resulting specific contact resistance value of 10-4ohm cm2 indicates capability of the layer as a practical device contact. The diamond thin film was grown homoepitaxially on high-pressure and high-temperature (HPHT) synthetic Ib diamond (100) substrate by microwave-plasma CVD method. 40keV Ar ions were irradiated at doses of 1x10(exp 14), 1x10(exp 15) and 1x10(exp 16) ions/cm2 under room-temperature. Then, Au/Pt/Ti were evaporated and patterned to make the TLM metal pads. The resulting contact resistances showed a strong dependence on the amount of Ar dose even at the higher dose region. The lowest contact resistance value of 10(-4) ohm cm(2) was obtained in the case of 1x10(exp 16) ions/cm2 doses after 400 annealing in nitrogen atmosphere. Farther, applying this metal / ion implanted layer structure as an ohmic contact, planer type Schottky barrier diodes were fabricated on high homo-epitaxial diamond films. Their current - voltage characteristics especially at a high temperature are also introduced and discussed.

Author

Diamond Films; Thin Films; Vapor Deposition; Argon; Ion Implantation

20030068639 Toshiba Corp., Japan

Electrical Properties of Doped and Undoped Homoepitaxial Diamond Layers Grown by Microwave Plasma CVD

Mariko, Suzuki; Yoshida, Hiroaki; Sakuma, Naoshi; Ono, Tomio; Sakai, Tadashi; Ogura, Masahiko; Okushi, Hideyo; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 164; In English; See also 20030068525; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

The electrical properties of homoepitaxial diamond layers have been investigated by I-V, C-V and frequency-dependent capacitance measurements. Undoped and B-doped diamond layers were grown by microwave plasma CVD on Ib (100) diamond substrates. Lateral Schottky barrier diodes were fabricated on these diamond layers. Individual Schottky contact (Au/Ni dot electrode) was surrounded by the ohmic contact (Au/Pt/Ti) with 20 micron gap. The contact pads have three kinds of area, which were 7.5 x 10(exp -4) square centimeters, 3.4 x 10(exp -4) square centimeters and 2.0 x 10(exp -4) square centimeters, respectively. The ohmic contact area was greater than 150 times that of the largest dot. B, N, H, and O concentrations were determined by SIMS measurements. The ideality factor n and barrier height for the Schottky junctions were typically found to be in 1.2 to approximately 1.3 and to be approximately 1.1eV, respectively, from the results of I-V measurements. The results of frequency-dependent capacitance measurements, with a frequency ranging from 10 Hz to 1 MHz, have shown the well-known dispersion effect, which occurs when a deep level is unable to follow the high-frequency voltage modulation and contribute to the net space charge in the depletion region. Net acceptor concentrations in the B-doped diamond layers were found to be 1-6 x 10(exp 17) per cubic centimeter. The correlation between net acceptor concentration and B concentration was revealed.

Author

Diamonds; Doped Crystals; Electrical Properties; Fabrication; Microwaves; Plasmas (Physics); Vapor Deposition

20030068640 Nippon Telegraph and Telephone Public Corp., Atsugi, Japan

Optical and Electric Properties of (111)-Oriented Diamond Homoepitaxial Layer

Kasu, M.; Aleksov, A.; Teofilov, N.; Kubovic, M.; Taniyasu, Y.; Sauer, R.; Kohn, E.; Makimoto, T.; Kobayashi, N.; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 165-170; In English; See also 20030068525; Original contains color illustrations; No Copyright; Avail: CASI; A02, Hardcopy

We have obtained high-quality (111)-oriented homoepitaxial layers with a low density of stacking faults. From the (111)-oriented layers, we observed well-resolved free-exciton transitions in cathodoluminescence at 13 K. In Raman scattering spectrum the line width of diamond-related peak was as low as 1.9 cm-1. A field-effect transistor with an 11 m-long gate exhibited maximum normalized current of 24 mA/mm. We fabricated metal-semiconductor (MES) field-effect transistors (FETs) that exhibited high performance of radio-frequency (RF) characteristics (transit frequency, fT, of 20 GHz and maximum frequency of oscillation via the maximum available gain, fmaxMAG, of 50 GHz. We clarified the formation

mechanism of stacking faults in (111)-oriented homoepitaxial layers. We found that the surface with a higher density of stacking faults exhibits a lower conductivity and obtained high quality homoepitaxial layer with a low density of stacking faults. In this presentation, we describe electrical and optical properties of (111)-oriented homoepitaxial diamond layers of high quality. From these layers, we observed well-resolved free-exciton transitions in cathodoluminescence (CL), and a sharp peak in Raman scattering. Using the layers, we fabricated FETs for the first time using (111)- orientation.
Author
Diamond Films; Electrical Properties; Optical Properties; Crystal Structure; Electroepitaxy; Vapor Deposition

20030068645 Nippon Inst. of Tech., Japan
Fabrication of 3-D Shaped Micro Body Structures of Diamond by Use of Focused Ion Beam
Murakawa, Masao; Noguchi, Hiroyuki; Takeuchi, Sadao; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 185-190; In English; See also 20030068525; Original contains black and white illustrations; No Copyright; Avail: CASI; A02, Hardcopy

Diamond is believed to be a suitable candidate material for micro- and nanotechnology due to its extreme hardness. However, this very property of diamond also makes its processing very difficult. More specifically, the processing of diamond by grinding with a fine powder of diamond itself is indeed possible if the grinding shape is a planar one, but the processing of diamond into a 3-D shape by grinding is very difficult. Furthermore, in the case of diamond processing by means of ion milling, the shape is limited to a 2.5-D one and the processing speed is very low as well. The use of a focused ion beam (FIB) device could be an alternative means for processing diamond. It has been generally used as a means for preparing specimen materials for electron microscopy by sectional cutting along a certain area of the material or slicing the material into very thin flakes ranging from 100 nm to 50 nm in thickness. Although FIB device technology has been advancing in that the devices can now deal with nanometer sizes due to the very fine diameter of the ion beam, generally speaking, it is not very suitable for precision processing of 3-D shapes. Accordingly, the purpose of this paper is to introduce a FIB device which has been designed to enable the precision processing of diamond into 3-D body shapes. This has been made possible by the introduction of various additional features of the device for precision 3-D processing of any kind of specimen including even the hardest material, diamond. The features of the device include: a U-centric mechanism whereby we can retain the focused point on the specimen even when the specimen is inclined; processing capability of any configuration on a plane; processing using bit map data; controllability of irradiation period of each single beam. These combined features render the device optimally suitable for use as a tool for fabrication, e.g., micromachines of any 3-D shape fabricated of any material including diamond. In this work we introduce several fancy demonstrations of diamond single crystal or very thick DLC having a 3-D configuration, which are made possible for the first time by the use of this sophisticated FIB device.
Author
Electron Microscopy; Fabrication; Microelectromechanical Systems; Diamonds; Nanotechnology

20030068647 Nippon Inst. of Tech., Japan
Evaluation of Mechanical Properties of High-Toughness Multilayered Diamond Films
Takeuchi, S.; Kojima, M.; Murakawa, M.; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 197-200; In English; See also 20030068525; Original contains black and white illustrations; No Copyright; Avail: CASI; A01, Hardcopy

When diamond is used as a wear-resistant material for tools, its unique wear resistance cannot be fully exploited due to the possibility of brittle fracture. In general, diamond films synthesized by the vapor phase method are polycrystalline and exhibit columnar crystal growth. In the polycrystalline structure, once cracks occur on the surface of the film, they tend to propagate through the columnar particles, leading to decreased toughness. The authors succeeded in synthesizing multilayered diamond films by repeated application of the bias-enhanced hot filament method. The multilayered films were superior in surface roughness, and the bending strength of the film was approximately 30% higher than that of a conventionally produced diamond film. In this study, we synthesized multilayered diamond film by the hot filament method using a WC-Co alloy substrate, and evaluated the adhesion strength for use in anti-wear parts.
Author
Diamond Films; Abrasion Resistance; Crystal Growth; Flexural Strength; Mechanical Properties

20030068649 Academy of Sciences (USSR), Moscow, USSR

Scanning Probe Microscopy of Carbon-Nanoparticle-Based Emitters

Frolov, V. D.; Karabutov, A. V.; Konov, V. I.; Pimenov, S. M.; Detkov, P. Y.; Ovsyakov, V. V.; Loubnin, E. N.; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 179-184; In English; See also 20030068525; Original contains color and black and white illustrations

Contract(s)/Grant(s): ISTC Proj. 1400; No Copyright; Avail: CASI; A02, Hardcopy

The techniques of scanning tunneling microscopy/spectroscopy (STM/STS) and atomic force microscopy/ spectroscopy (AFM/AFS) with conductive cantilevers are applied to study electronic properties of the emission sites in field electron emitters based on carbon nanoparticles (nanodiamonds, carbon nanotubes). The emitters are produced by (i) electrochemical codeposition of metals with nanodiamond, (ii) electrophoretic deposition of single-wall carbon nanotubes, and (iii) shock-wave compacting/implantation of carbon nanoparticles into metal layers. STM analysis of the emitter surface allows to get mapping of the surface relief, field emission, surface electron potential, and local electroconductivity. It is generally found that the position of the emission sites is coincident with high-conducting regions where the surface electron potential is lowered. In addition, the STS/AFS data showed different character of local conductivity in nm-sized surface regions of the nanodiamond- and nanotube-based emitters. The obtained data provide further support for the field emission model based on the analysis of the field-enhanced emissivity of low-dimensional regions due to the quantum well effect, which has been previously proposed to account for the low-field electron emission from nanocrystalline diamond and nitride films.

Author

Scanning Tunneling Microscopy; Field Emission; Carbon Nanotubes; Atomic Force Microscopy; Nanoparticles; Emitters

20030068652 Waseda Univ., Tokyo, Japan

Diamond Field Effect Transistors for Microwave Devices and Biosensing Applications

Kawarada, H.; Umezawa, H.; Miyamoto, S.; Matsudaira, H.; Song, K.-S.; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 174-177; In English; See also 20030068525; Original contains color and black and white illustrations; No Copyright; Avail: CASI; A01, Hardcopy

Due to its extreme properties, diamond is expected to be the ultimate semiconductor device. However, its progress as an active device has been slow because there has been no doping technology developed to realize its high electrical conductance. We focused on a highly conductive p-type layer appearing on a hydrogen terminated diamond surface and developed surface channel field effect transistors (FETs). In this study, we demonstrate that this type of FET is applicable in high-frequency devices operating at high power and biosensors in electrolyte solution.Among wide band gap semiconductors, diamond has large band gap (5.5 eV). The breakdown field is 2-3 times as large as that of SiC or GaN. Due to its strong covalent bonds, it exhibits the highest thermal conductivity, 4 times as large as that of SiC. The figures of merit for high power, high frequency, and integrated devices calculated from these physical properties far exceed those of other semiconductors. Although p-type carrier control can be done by boron, the acceptor level is so deep (0.37ev) that the carrier concentration at room temperature is very low resulting in low transconductance less than 1mS/mm in conventional FETs. Compared with the boron doped layer, the surface conductive layer of hydrogen-terminated (H-terminated) diamond has suitable properties for FETs, because high surface carrier concentration (1013 cm-2) is obtained with shallow carrier profiles where 90 % carriers exist less than 10 nm from the surface. Moreover, ohmic contacts can be obtained because of the low Schottky barrier heights at the H-terminated surfaces. These advantages are summarized in Fig.1. Up to now relative high transconductances of 50-150mS/mm have been obtained in metal-semiconductor (MES) FETs or metal-insulator-semiconductor (MIS) FETs using the H-terminated diamond surfaces (refs 1 to 3). On the other hand, conductive polycrystalline diamonds doped with high density (1019cm-3) boron are normally used for the electrochemical electrodes which attract attentions because of wide potential windows of 3.0-3.5 eV more than 1eV wider than glassy carbon or Pt used as normal electrochemical electrode. The p-type surface conductive layer can be also used this purpose, because the surface of diamond is chemically inert and biocompatible. Within the potential window, the FET operation with the electrolyte solution as gate can be expected. In the present paper we are going to show the two types of application from the point of RF operation and biosensing of surface channel diamond FETs which exhibit high transconductance and operations in electrolyte solution.

Author

Field Effect Transistors; Semiconductor Devices; Microwave Equipment; Polycrystals; Boron; Hydrogen; Crystal Surfaces

20030068670 Nippon Inst. of Tech., Japan

A System Made of Diamond for Assembling Microelements

Nakazato, Yuichi; Sekine, Akiyoshi; Sekine, Goro; Miyazawa, Hajime; Takeuchi, Sadao; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 207-212; In English; See also 20030068525; Original contains black and white illustrations; No Copyright; Avail: CASI; A02, Hardcopy

Diamond is a high performance material in many ways, i.e., having mechanically the highest hardness, thermally the highest thermal conductivity, chemically high stability in various atmospheres at ordinary temperatures, and electrically high insulation. The goal of this study is to fabricate a maintenance-free micromachine system equipped with diamond elements that can work under severe conditions, in human body for example, for a long period. As the first step of this study, the authors made a micromanipulator having diamond end effector that can handle micro elements, as small as several to several ten micrometers, made of diamond. The shape of end effector was first designed and the distribution of stress caused during its operation was stimulated by the FEM method to avoid possible harmful stress concentration. Then, a homemade thick CVD diamond film was cut by a YAG laser to define the final configuration of the effector. Then a coil made a thin shape memory alloy wire, superior to electrostatic and/or piezoelectric devices in power-weight ratio and acceptable driving range, was used for the actuator. The manipulator produced worked satisfactorily to grip and locate diamond micro elements of the size described.
Author
Diamond Films; Shape Memory Alloys; Thermal Conductivity; Hardness; End Effectors; Microelectromechanical Systems; Stress Concentration

20030068671 Jilin Univ., Changchun, China
Influence of the DC Substrate Bias on the Filed Emission of Amorphous Carbon Nitride Films Deposited on Silicon Tips Arrays
Li, J. J.; Zheng, W. T.; Jin, Z. S.; Lu, X. Y.; Li, Z. K.; Jin, Z.; Sun, L.; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 493; In English; See also 20030068525; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

Amorphous carbon nitride films were deposited on silicon tip arrays by rf magnetron sputtering in pure nitrogen atmosphere. Effect of DC substrate negative bias on electron filed emission properties of as-deposited carbon nitride films was investigated. The field emission property of carbon nitride films on tips was compared with that on silicon wafer. The result shows carbon nitride films deposited on tips possess a stable field emission with lower threshold field, which is more excellent than that on wafer. This result has relation to the change of the local curvature and geometry of the films surface. But DC substrate bias will reduce the filed emission property of carbon nitride films on silicon tips during deposition, which can explained that the bias causes a blunter silicon tips due to the damage by high-energy ions bombardment during increasing substrate bias. On the other hand, the effective work function of the films is increased with DC substrate bias, which indicates the decrease of electron field emission of the films.
Author
Amorphous Materials; Carbon Nitrides; Silicon; Substrates; Deposition; Bias; Diamonds; Coatings

20030068673 Osaka Univ., Osaka, Japan
Aurora PLD Growth of CaF2 Thin Film and Application to Improved CaF2/Diamond MIS Interface Formation
Honda, Shigeto; Komatsu, Shinsuke; Kobayashi, Takeshi; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 244-249; In English; See also 20030068525; Original contains color and black and white illustrations; No Copyright; Avail: CASI; A02, Hardcopy

For the realization of a high quality diamond MIS device, we so far proposed to utilize CaF2 as the non-oxide gate insulator. CaF2 has been long prepared by the evaporation method. Recently, we introduced the pulsed laser deposition (PLD) method and fabricated diamond MIS diodes by PLD. To look at more improvement of the CaF2/diamond MIS interface, we started to study the aurora PLD (using the magnetic field) for CaF2 film formation in addition to the conventional PLD. Aurora method is characterized by the enhanced ionization and/or activation of ablated particles during transport from the target to substrate through interaction between the particles and applied magnetic fields and expected to obtain better quality of film. Plume emission spectroscopic measurements have revealed that the aurora PLD plume emission admirably increased more than 30 times higher than conventional one. Time-resolved plume image analyses have closely been done.
Author
Diamond Films; Calcium Fluorides; Pulsed Laser Deposition; Mis (Semiconductors)

20030068792 NASA Glenn Research Center, Cleveland, OH, USA
Silicon Carbide Diodes Performance Characterization and Comparison With Silicon Devices
Lebron-Velilla, Ramon C.; Schwarze, Gene E.; Trapp, Scott; August 2003; 15 pp.; In English; First International Energy Conversion Engineering Conference, 17-21 Aug. 2003, Portsmouth, VA, USA
Contract(s)/Grant(s): WBS 22-755-60-15
Report No.(s): NASA/TM-2003-212511; E-14071; NAS 1.15:212511; No Copyright; Avail: CASI; A03, Hardcopy

Commercially available silicon carbide (SiC) Schottky diodes from different manufacturers were electrically tested and characterized at room temperature. Performed electrical tests include steady state forward and reverse I-V curves, as well as switching transient tests performed with the diodes operating in a hard switch dc-to-dc buck converter. The same tests were performed in current state of the art silicon (Si) and gallium arsenide (GaAs) Schottky and pn junction devices for evaluation and comparison purposes. The SiC devices tested have a voltage rating of 200, 300, and 600 V. The comparison parameters are forward voltage drop at rated current, reverse current at rated voltage and peak reverse recovery currents in the dc to dc converter. Test results show that steady state characteristics of the tested SiC devices are not superior to the best available Si Schottky and ultra fast pn junction devices. Transient tests reveal that the tested SiC Schottky devices exhibit superior transient behavior. This is more evident at the 300 and 600 V rating where SiC Schottky devices showed drastically lower reverse recovery currents than Si ultra fast pn diodes of similar rating.
Author
Schottky Diodes; Silicon Carbides; Electric Equipment Tests; Semiconductors (Materials); Fabrication

20030068896 NASA Pasadena Office, CA, USA
Structure of Thin-Film Lithium Microbatteries
Whitacre, Jay F., Inventor; Bugga, Ratnakumar V., Inventor; West, William C., Inventor; May 06, 2003; 13 pp.; In English Patent Info.: Filed 8 Feb. 2001; US-Patent-6,558,836; US-Patent-Appl-SN-779595; NASA-Case-NPO-21015; No Copyright; Avail: CASI; A03, Hardcopy

A process for making thin-film batteries including the steps of cleaning a glass or silicon substrate having an amorphous oxide layer several microns thick; defining with a mask the layer shape when depositing cobalt as an adhesion layer and platinum as a current collector; using the same mask as the preceding step to sputter a layer of LiC(0)O2, on the structure while rocking it back and forth; heating the substrate to 300 C. for 30 minutes; sputtering with a new mask that defines the necessary electrolyte area; evaporating lithium metal anodes using an appropriate shadow mask; and, packaging the cell in a dry-room environment by applying a continuous bead of epoxy around the active cell areas and resting a glass slide over the top thereof. The batteries produced by the above process are disclosed.
Official Gazette of the U.S. Patent and Trademark Office
Electric Batteries; Thin Films; Lithium

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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*.

20030067705 NASA Ames Research Center, Moffett Field, CA, USA
Implementation of Premixed Equilibrium Chemistry Capability in OVERFLOW
Olsen, M. E.; Liu, Y.; Vinokur, M.; Olsen, T.; [2003]; 7 pp.; In English; 42nd AIAA Aerospace Science Meeting and Exhibit, 6-9 Jan. 2003, Reno, NV, USA; Original contains black and white illustrations; No Copyright; Avail: CASI; A02, Hardcopy

An implementation of premixed equilibrium chemistry has been completed for the OVERFLOW code, a chimera capable, complex geometry flow code widely used to predict transonic flowfields. The implementation builds on the computational efficiency and geometric generality of the solver.
Author
Flow Distribution; Chemical Equilibrium; Premixing; Thermodynamics; Mathematical Models; Computer Programs

20030067772 DCW Industries, Inc., La Canada, CA
Projectile Base Flow Analysis
Wilcox, David C.; Feb. 28, 2003; 13 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): DAAD19-02-C-0063
Report No.(s): AD-A414763; DCW-38-R-05; ARO-44013-EG-II; No Copyright; Avail: CASI; A03, Hardcopy

The primary purpose of this research project has been to analyze, through detailed plots and analysis, results obtained in ARO Contract DAAD19-99-C-0047. We have also determined model-predicted effects of base bleed on projectile base flows. In clarifying the impact of model revisions made to the Wilcox Stress-model in Contract DAAD19-99-C-004, we have revised and improved surface boundary conditions for both the Stress- and k- models. Detailed mean-flow and turbulence-property profile plots show that the k- model predictions are closer to measurements than those of the Stress- model and those of

computations done by other researchers using the k- model. A grid resolution study confirms that the numerical results obtained in our computations are accurate. Numerical experiments seeking improvements in predicted results using the Stress- model failed to achieve any significant improvement. Attempts to improve k- model predictions with a nonlinear stress/Strain-rate constitutive relation also proved ineffective. Predictions for effects of base bleed are consistent with measurements and are similar to those obtained in other research studies.
DTIC
Numerical Analysis; Projectiles; Stress-Strain Relationships; Stress Analysis; Surface Properties

20030067790 National Inst. of Standards and Technology, Gaithersburg, MD
User's Guide for Smokeview Version 3.1: A Tool for Visualizing Fire Dynamics Simulation Data
Forney, G.; McGrattan, K.; Apr. 2003; In English
Report No.(s): PB2003-105977; NISTIR-6980; No Copyright; Avail: National Technical Information Service (NTIS)

Smokeview is a software tool designed to visualize numerical calculations generated by the NIST Fire Dynamics Simulator (FDS), a computational fluid dynamics (CFD) model of fire-driven fluid flow. These two tools are typically used together to respectively simulate and visualize the flow of smoke induced by a fire. Smokeview visualizes FDS modelling results by displaying: particle flow, 2D or 3D shaded contours of gas flow data such as temperature and flow vectors showing flow direction and magnitude. Smokeview also visualizes static data at particular times again using 2D or 3D contours of data such as temperature and flow vectors showing flow direction and magnitude. Examples of each visualization type are given.
NTIS
Computational Fluid Dynamics; Fluid Flow; Smoke; Flow Visualization; Computerized Simulation; User Manuals (Computer Programs)

20030067802 Lawrence Livermore National Lab., Livermore, CA
High-Wavenumber Viscosity for High-Resolution Numerical Methods
Cook, A. W.; Cabot, W. H.; Feb. 19, 2003; 24 pp.; In English
Report No.(s): DE2003-15003408; UCRL-ID-152002; No Copyright; Avail: Department of Energy Information Bridge

In the report, the authors propose a high-wavenumber formulation for artificial viscosity as a means of stabilizing high-order methods and reducing oscillations near discontinuities.
NTIS
Numerical Analysis; Viscosity

20030067819 NASA Marshall Space Flight Center, Huntsville, AL, USA
A Novel Approach for Modeling Chemical Reaction in Generalized Fluid System Simulation Program
Sozen, Mehmet; Majumdar, Alok; [2002]; 3 pp.; In English; 39th AIAA/ASME/SAE/ASEE Joint Propulsion Conference and Exhibit, 20-23 Jul. 2003, Huntsville, AL, USA; Copyright; Avail: CASI; A01, Hardcopy

The Generalized Fluid System Simulation Program (GFSSP) is a computer code developed at NASA Marshall Space Flight Center for analyzing steady state and transient flow rates, pressures, temperatures, and concentrations in a complex flow network. The code, which performs system level simulation, can handle compressible and incompressible flows as well as phase change and mixture thermodynamics. Thermodynamic and thermophysical property programs, GASP, WASP and GASPAK provide the necessary data for fluids such as helium, methane, neon, nitrogen, carbon monoxide, oxygen, argon, carbon dioxide, fluorine, hydrogen, water, a hydrogen, isobutane, butane, deuterium, ethane, ethylene, hydrogen sulfide, krypton, propane, xenon, several refrigerants, nitrogen trifluoride and ammonia. The program which was developed out of need for an easy to use system level simulation tool for complex flow networks, has been used for the following purposes to name a few: Space Shuttle Main Engine (SSME) High Pressure Oxidizer Turbopump Secondary Flow Circuits, Axial Thrust Balance of the Fastrac Engine Turbopump, Pressurized Propellant Feed System for the Propulsion Test Article at Stennis Space Center, X-34 Main Propulsion System, X-33 Reaction Control System and Thermal Protection System, and International Space Station Environmental Control and Life Support System design. There has been an increasing demand for implementing a combustion simulation capability into GFSSP in order to increase its system level simulation capability of a liquid rocket propulsion system starting from the propellant tanks up to the thruster nozzle for spacecraft as well as launch vehicles. The present work was undertaken for addressing this need. The chemical equilibrium equations derived from the second law of thermodynamics and the energy conservation equation derived from the first law of thermodynamics are solved

simultaneously by a Newton-Raphson method. The numerical scheme was implemented as a User Subroutine in GFSSP.
Author
Computer Programs; Computerized Simulation; Chemical Reactions; Liquid Propellant Rocket Engines; Flow Visualization

20030067904 Office National d'Etudes et de Recherches Aeronautiques, France
Statistical Study of Turbulence: Spectral Functions and Correlation Coefficients
Frenkiel, Francois N.; ONERA; July 1958, No. 34; 119 pp.; In English
Report No.(s): NACA-TM-1436; No Copyright; Avail: CASI; A06, Hardcopy

In reading the publications on turbulence of different authors, one often runs the risk of confusing the various correlation coefficients and turbulence spectra. We have made a point of defining, by appropriate concepts, the differences which exist between these functions. Besides, we introduce in the symbols a few new characteristics of turbulence. In the first chapter, we study some relations between the correlation coefficients and the different turbulence spectra. Certain relations are given by means of demonstrations which could be called intuitive rather than mathematical. In this way we demonstrate that the correlation coefficients between the simultaneous turbulent velocities at two points are identical, whether studied in Lagrange's or in Euler's systems. We then consider new spectra of turbulence, obtained by study of the simultaneous velocities along a straight line of given direction. We determine some relations between these spectra and the correlation coefficients. Examining the relation between the spectrum of the turbulence measured at a fixed point and the longitudinal-correlation curve given by G. I. Taylor, we find that this equation is exact only when the coefficient is very small.
Author
Statistical Analysis; Turbulence; Spectra; Correlation Coefficients

20030067911 Purdue Univ., West Lafayette, IN, USA
Investigation of Critical Heat Flux in Reduced Gravity Using Photomicrographic Techniques
Mudawar, Issam; Zhang, Hui; August 2003; 123 pp.; In English
Contract(s)/Grant(s): NAG3-2336; No Copyright; Avail: CASI; A06, Hardcopy

Experiments were performed to examine the effects of body force on flow boiling critical heat flux (CHF). FC-72 was boiled along one wall of a transparent rectangular flow channel that permitted photographic study of the vapor-liquid interface just prior to CHF. High-speed video imaging techniques were used to identify dominant CHF mechanisms corresponding to different flow orientations and liquid velocities. Six different CHF regimes were identified: Wavy Vapor Layer, Pool Boiling, Stratification, Vapor Counterflow, Vapor Stagnation, and Separated Concurrent Vapor Flow. CHF showed significant sensitivity to orientation for flow velocities below 0.2 m/s, where extremely low CHF values where measured, especially with downward-facing heated wall and downflow orientations. High flow velocities dampened the effects of orientation considerably. The CHF data were used to assess the suitability of previous CHF models and correlations. It is shown the Interfacial Lift-off Model is very effective at predicting CHF for high velocities at all orientations. The flooding limit, on the other hand, is useful at estimating CHF at low velocities and for downflow orientations. A new method consisting of three dimensionless criteria is developed for determining the minimum flow velocity required to overcome body force effects on near-saturated flow boiling CHF. Vertical upflow boiling experiments were performed in pursuit of identifying the trigger mechanism for subcooled flow boiling CHF. While virtually all prior studies on flow boiling CHF concern the prediction or measurement of conditions that lead to CHF, this study was focused on events that take place during the CHF transient. High-speed video imaging and photomicrographic techniques were used to record the transient behavior of interfacial features from the last steady-state power level before CHF until the moment of power cut-off following CHF. The video records show the development of a wavy vapor layer which propagates along the heated wall, permitting cooling prior to CHF only in wetting fronts corresponding to the wave troughs. Image analysis software was developed to estimate void fraction from the individual video images. The void fraction records for subcooled flow boiling show the CHF transient is accompanied by gradual lift-off of wetting fronts culminating in some maximum vapor layer mean thickness, following which the vapor layer begins to thin down as the transition to film boiling ensues. This study proves the Interfacial Lift-off Model, which has been validated for near-saturated flow boiling CHF, is equally valid for subcooled conditions.
Author
Heat Flux; Microgravity; Photomicrography; Liquid-Vapor Interfaces

20030067963 NASA Glenn Research Center, Cleveland, OH, USA

Gust Acoustic Response of a Single Airfoil Using the Space-Time CE/SE Method

Scott, James, Technical Monitor; Wang, X. Y.; Chang, S. C.; Himansu, A.; Jorgenson, P. C. E.; August 2003; 18 pp.; In English; 40th Aerospace Sciences Meeting and Exhibit, 14-17 Jan. 2002, Reno, NV, USA

Contract(s)/Grant(s): NAS3-97186; WU 708-90-33

Report No.(s): NASA/TM-2003-211513; E-13305; NAS 1.15:211513; AIAA Paper 2002-0801; No Copyright; Avail: CASI; A03, Hardcopy

A 2D parallel Euler code based on the space-time conservation element and solution element (CE/SE) method is validated by solving the benchmark problem I in Category 3 of the Third CAA Workshop. This problem concerns the acoustic field generated by the interaction of a convected harmonic vortical gust with a single airfoil. Three gust frequencies, two gust configurations, and three airfoil geometries are considered. Numerical results at both near and far fields are presented and compared with the analytical solutions, a frequency-domain solver GUST3D solutions, and a time-domain high-order Discontinuous Spectral Element Method (DSEM) solutions. It is shown that the CE/SE solutions agree well with the GUST3D solution for the lowest frequency, while there are discrepancies between CE/SE and GUST3D solutions for higher frequencies. However, the CE/SE solution is in good agreement with the DSEM solution for these higher frequencies. It demonstrates that the CE/SE method can produce accurate results of CAA problems involving complex geometries by using unstructured meshes.

Author

Gusts; Airfoils; Acoustics; Euler Equations Of Motion; Space-Time Ce/Se Method; Frequency Domain Analysis

20030067970 Naval Postgraduate School, Monterey, CA

Effects of Short Crested Seas on the Motions of a Trolley Interfact for Ship-to-Ship Cargo Transfer

Shin, Chong K.; Mar. 2003; 116 pp.; In English; Original contains color illustrations

Report No.(s): AD-A414843; No Copyright; Avail: CASI; A06, Hardcopy

This thesis sets out to explore the effects on the dynamic response of a hybrid trolley system, employed in ship to shore cargo transfer operating in a realistic short crested irregular seaway. Compared to the multi-directional long crested waves, the multi-directional nature of short crested waves enhances the realism of the modeling. A standard cosine-squared spreading law was added to the two-parameter Bretschneider spectrum. The results provide added data on the coupled system response in all directions and moderate any overestimation that may be derived from simply using long crested waves.

DTIC

Mathematical Models; Cargo; Ships; Data Systems

20030068130 NASA Marshall Space Flight Center, Huntsville, AL, USA

Internal Flow Thermal/Fluid Modeling of STS-107 Port Wing in Support of the Columbia Accident Investigation Board

Sharp, John R.; Kittredge, Ken; Schunk, Richard G.; [2003]; 22 pp.; In English; Thermal and Fluids Analysis Workshop 2003, 18-22 Aug. 2003, Hampton, VA, USA; No Copyright; Avail: CASI; A03, Hardcopy

As part of the aero-thermodynamics team supporting the Columbia Accident Investigation Board (CAB), the Marshall Space Flight Center was asked to perform engineering analyses of internal flows in the port wing. The aero-thermodynamics team was split into internal flow and external flow teams with the support being divided between shorter timeframe engineering methods and more complex computational fluid dynamics. In order to gain a rough order of magnitude type of knowledge of the internal flow in the port wing for various breach locations and sizes (as theorized by the CAB to have caused the Columbia re-entry failure), a bulk venting model was required to input boundary flow rates and pressures to the computational fluid dynamics (CFD) analyses. This paper summarizes the modeling that was done by MSFC in Thermal Desktop. A venting model of the entire Orbiter was constructed in FloCAD based on Rockwell International s flight substantiation analyses and the STS-107 reentry trajectory. Chemical equilibrium air thermodynamic properties were generated for SINDA/FLUINT s fluid property routines from a code provided by Langley Research Center. In parallel, a simplified thermal mathematical model of the port wing, including the Thermal Protection System (TPS), was based on more detailed Shuttle re-entry modeling previously done by the Dryden Flight Research Center. Once the venting model was coupled with the thermal model of the wing structure with chemical equilibrium air properties, various breach scenarios were assessed in support of the aero-thermodynamics team. The construction of the coupled model and results are presented herein.

Author

Accident Investigation; Columbia (Orbiter); Space Shuttle Missions; Aerothermodynamics; Internal Flow; Mathematical Models; Wings; Computational Fluid Dynamics

20030068141 NASA Marshall Space Flight Center, Huntsville, AL, USA
Solutal Convection in a Magnetic Fluid
Leslie, Fred; Ramachandran, N.; [2003]; 1 pp.; In English; No Copyright; Avail: Other Sources; Abstract Only

A theoretical and experimental study is presented on the stability of solutal convection of a magnetized fluid in the presence of a magnetic field. The total force on the fluid is derived and equilibrium positions are computed establishing the field necessary to counter fluid buoyancy. The requirements for stability are developed and compared with experiments with a paramagnetic fluid. The experiments are in good agreement not only with the theoretical predictions for equilibrium but also verify the stability theory which predicts both horizontal and vertical stability. Analogous to results for levitation, the theory indicates that solutal convection in paramagnetic fluids cannot be completely stabilized while that in diamagnetic liquid are possible.

Author
Convection; Magnetic Fields; Diamagnetism

20030068147 California Univ., Davis, CA, USA, Pacific Northwest National Lab., Richland, WA, USA
On-Line Slurry Viscosity and Concentration Measurement as a Real-Time Waste Stream Characterization Tool
Powell, R. L.; Shekarriz, A.; 2003; 7 pp.; In English
Report No.(s): DE2003-13491; No Copyright; Avail: Department of Energy Information Bridge

The overall goal is to obtain real-time rheology and solids concentration within a solid-liquid suspension flowing in a pipeline. To nondestructively obtain the rheology of the fluid flowing in a pipe, accurate measurement of local shear rate distribution is required. This objective was met by using two real-time tomographic techniques: an ultrasonic Doppler velocimetry system and an NMRI system. The first method combines the existing state-of-the-art ultrasonic velocimetry technology base with a novel tomographic concept to non-intrusively obtain high resolution acoustic and flow velocity profile at a section of the flow field. The acoustic velocity profile provides a means of improving the flow velocity measurement accuracy. These data are also, used to yield the profile of solids concentration. In addition, the volumetric flow rate was determined from integration of the velocity profile. From the knowledge of the concentration profile the mass flow rate can also be determined, Similar work was undertaken for the NMNRI system. In this case, single phase Newtonian fluids have been used to model complex rheological behavior. Finally, a LDV system has been purchased and set - up in the laboratory at UC Davis.

NTIS
Real Time Operation; Rheology; Slurries; Viscosity; Radioactive Wastes

20030068360 Pacific Northwest National Lab., Richland, WA, USA, Westinghouse Hanford Co., Richland, WA, USA
Fluid Dynamics, Particulate Segregation, Chemical Processes, Natural Ore Analog and Tank Inventory Discussions that Relate to the Potential for Criticality in Hanford Tanks
Sep. 30, 1996; 453 pp.; In English
Report No.(s): DE2003-16768; WHC-SD-WM-TI-757; No Copyright; Avail: Department of Energy Information Bridge

This report presents an in-depth review of the potential for nuclear criticality to occur in Hanford defense waste tanks during past, current and future safe storage and maintenance operations. The report also briefly discusses the potential impacts of proposed retrieval activities, although retrieval was not a main focus of scope. After thorough review of fluid dynamic aspects that focus on particle segregation, chemical aspects that focus on solubility and adsorption processes that might concentrate plutonium and/or separate plutonium from the neutron absorbers in the tank waste, and ore-body formation and mining operations, the interdisciplinary team has come to the conclusion that there is negligible risk of nuclear critically under existing storage conditions in Hanford Site underground water storage tanks. Further, for the accident scenarios considered an accidental criticality is incredible. The executive summary and summaries at the end of each section in which substantial analyses, calculations or literature interpretations were performed provide more detailed findings and support for these conclusions.

NTIS
Storage Tanks; Underground Storage; Particulates

20030068385 NASA Marshall Space Flight Center, Huntsville, AL, USA
Numerical Modeling of Thermofluid Transients During Chilldown of Cryogenic Transfer Lines
Majumdar, Alok; Steadman, Todd; [2003]; 3 pp.; In English; 33rd International Conference on environmental Systems, 7-14 Jul. 2003, Vancouver, BC, Canada; Copyright; Avail: CASI; A01, Hardcopy

The chilldown of fluid transfer lines is an important part of using cryogenic systems such as those found in both ground and space based applications. The chilldown process is a complex combination of both thermal and fluid transient phenomena. A cryogenic liquid flows through a transfer line that is initially at a much higher temperature than the cryogen. Transient heat transfer processes between the liquid and transfer line cause vaporization of the liquid, and this phase change can cause transient pressure and flow surges in the liquid. As the transfer line is cooled, these effects diminish until the liquid reaches a steady flow condition in the chilled transfer line. If these transient phenomena are not properly accounted for in the design process of a cryogenic system, it can lead to damage or failure of system components during operation. For such cases, analytical modeling is desirable for ensuring that a cryogenic system transfer line design is adequate for handling the effects of a chilldown process. The purpose of this paper is to present the results of a numerical model developed using Generalized Fluid System Simulation Program (GFSSP)'s new fluid transient capability in combination with its previously developed thermal transient capability to predict pressure and flow surge in cryogenic transfer lines during a chilldown process. An experiment performed by the National Bureau of Standards (NBS) in 1966 has been chosen as the baseline comparison case for this work. NBS s experimental set-up consisted of a 10.59 cu ft supply dewar, an inlet valve, and a 200 ft long, - in Outside Diameter (OD) vacuum jacketed copper transfer line that exhausted to atmosphere. Three different inlet valves, a - in port ball valve, a 1 in port globe valve and a 1 in port gate valve, were used in NBS s experiments. Experiments were performed using both liquid hydrogen and liquid nitrogen as the fluids. The proposed paper will include detailed comparisons of GFSSP s predictions with NBS's experimental results.
Author
Mathematical Models; Cryogenic Equipment; Fluid Dynamics; Heat Transfer; Cryogenic Cooling; Cryogenic Fluids

20030068531 Hiroshima Prefectural Agriculture Research Center, Hiroshima, Japan
Thermodynamically Predicted C-H-O Phase Diagram
Tsutsumoto, Takahiro; Yamamoto, Akira; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 250-254; In English; See also 20030068525; No Copyright; Avail: CASI; A01, Hardcopy

A C-H-O diagram for carbon deposition from gas phase was thermodynamically calculated from free energies of formation of the limited chemical species, CH4, C2H2, CO and CO2, and C-H-O gas composition for diamond deposition was discussed. The feasible area of diamond deposition is in the vicinity of carbon solubility limit in the diagram. Solubility limit of carbon to hydrogen is much lower than that of carbon to oxygen, because the formation free energies of C2H2 and CH4 in C-H system are much higher than those of CO and CO2 in C-O system. The necessity of low C/H ratio in gas composition for diamond deposition comes from the low solubility limit of carbon to hydrogen. CO becomes extremely stable at higher temperatures. Therefore carbon is soluble up to C/O=1, which appears as the solubility line, called the 'CO line', in the C-H-O diagram. The vicinity of this solubility line shows a good agreement with C-H-O gas composition for diamond deposition.
Author
Thermodynamics; Diamonds; Vapor Deposition; Carbon; Hydrogen; Oxygen; Vapor Phases; Gas Composition; Phase Diagrams

20030068599 Tokyo Inst. of Tech., Tokyo, Japan
Solid Lubricant Properties of Catalytically Grown Carbon Nanotubes
Hirata, Atsushi; Yoshioka, Nobuaki; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 76-79; In English; See also 20030068525; Original contains black and white illustrations; No Copyright; Avail: CASI; A01, Hardcopy

Solid lubricant properties of carbon nanotubes catalytically deposited by microwave plasma CVD using methane and hydrogen gaseous mixture have been investigated by means of ball-on-disk type friction testing. Carbon nonotubes with various crystallinity were deposited by changing microwave power and bias voltage onto silicon substrate. Nickel was used as a catalyst and coated on the substrate by DC sputtering before deposition. SEM and Raman spectroscopy were employed to examine carbon nanotubes. In friction testing, a bearing steel ball slid on the substrate coated with carbon nanotubes or covered with vapor grown carbon fibers used as a reference carbon material. Friction force was measured in air containing water vapor, dry nitrogen and vacuum. As a result, low friction has resulted from the carbon nanotubes with fewer defects, in particular, in water-free atmosphere such as dry nitrogen and vacuum. Cemented carbide substrate has improved the adhesion of carbon nanotubes, and lower friction coefficient below 0.1 was consequently attained.
Author
Carbon Nanotubes; Catalytic Activity; Solid Lubricants; Adhesion; Friction

20030068602 Integrity Testing Lab., Inc., Markham, Ontario, Canada
Measurement of Apparent Thermal Conductivity of Nano Particles
Litovsky, Efim; Kleiman, Jacob; Koga, Yoshinori; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 87; In English; See also 20030068525; No Copyright; Avail: CASI; A01, Hardcopy

A new measurement method based on a proprietary, developed at ITL methodology for measurement of thermal conductivity of thin rods is being developed and used in a project aimed at measurement of thermal conductivity of various types of nano particles including single wall carbon nanotubes (SWCNT). The thermal conductivity of nano particles can be determined based on mathematical models of apparent thermal conductivity of mixtures of such particles with liquids. The different mathematical models take into account the shape of particles, their sizes, volume concentration and orientation f the particles inside the mixture. Measurement of apparent thermal conductivity of the prepared mixtures will be conducted using standard well-established methods. For reliable and stable results, very good wetting of the particles by the chosen liquid should be provided. A thorough study of wetting behavior of the SWCNT by liquids will be conducted and the most appropriate liquid will be chosen for experiments. Based on apparent thermal conductivity measurements and the above mathematical models, the thermal conductivity of nano particles of different shapes will be determined in different directions. Special theoretical corrections must be introduced and taken into account in building the model of the nanotubes with the liquid inside them. The introduced corrections will take into account the fact that the substitution of air by liquid will decrease the thermal conductivity (Kn number) behavior of the nanotubes interior.
Author
Carbon Nanotubes; Mathematical Models; Thermal Conductivity; Nanoparticles

20030068786 State Publishing House, Leningrad, Russia
Free Convection Under the Conditions of the Internal Problem
Ostroumov, G. A.; April 1958; 239 pp.; In English; Original contains black and white illustrations
Report No.(s): NACA-TM-1407; Rept-4281; No Copyright; Avail: CASI; A11, Hardcopy

Convection is called free is the stresses (including the normal pressure) to which the fluid is subjected at its boundaries do not perform mechanical work, that is, if all the boundaries of the fluid are stationary. The case where this is not true is termed forced convection. It corresponds to the action on the fluid of some mechanical suction pumping the fluid.
Derived from text
Free Convection; Gravitational Effects; Cross Sections

20030068803 National Advisory Committee for Aeronautics. Langley Aeronautical Lab., Langley Field, VA, USA
Pressure Distribution Measurements on a Turbine Rotor Blade Passing Behind a Turbine Nozzle Lattice
Hausenblas; Berichte der Gittertagung; September 1947, pp. 95-100; In English; Reports of the Lattice Conference: Berichte der Gittertagung, 27-27 March 1944, Brunswick,, Germany
Report No.(s): NACA-TM-1173; No Copyright; Avail: CASI; A02, Hardcopy

As a turbine rotor turns, the blades traverse the wake zones of the nozzle vanes. A periodic fluctuation of the pressure distribution around the circumference of the rotor blade is therefore caused. It was desired to investigate quantitatively this effect. At the same time, the magnitude of the force acting upon one profile of the rotor-blade lattice at various positions of this lattice relative to the nozzle lattice was to be determined.
Author
Pressure Distribution; Pressure Measurement; Turbine Blades; Rotors; Rotor Dynamics

20030068861 NASA Glenn Research Center, Cleveland, OH, USA
Stereo Imaging Velocimetry System and Method
McDowell, Mark, Inventor; August 05, 2003; 22 pp.; In English
Patent Info.: Filed 30 Aug. 2002; US-Patent-6,603,535; US-Patent-Appl-SN-232862; NASA-Case-LEW-17241-1; No Copyright; Avail: CASI; A03, Hardcopy

A system and a method is provided for measuring three dimensional velocities at a plurality of points in a fluid employing at least two cameras positioned approximately perpendicular to one another. Image frames captured by the cameras may be filtered using background subtraction with outlier rejection with spike-removal filtering. The cameras may calibrated to accurately represent image coordinates in a world coordinate system using calibration grids modified using warp transformations. The two-dimensional views of the cameras may be recorded fur image processing and particle track

determination. The tracer particles may be tracked on a two-dimensional basis and then stereo matched to obtain three-dimensional locations of the particles as a function of time so that velocities can be measured there from.
Official Gazette of the U.S. Patent and Trademark Office
Velocity Measurement; Three Dimensional Motion; Cameras; Imaging Techniques

20030068929 Naval Undersea Warfare Center, Newport, RI
Turbulent Boundary Layer Thickness Estimation Method and Apparatus
Keith, William L., Inventor; Apr. 2, 2003; 18 pp.; In English
Patent Info.: Filed 10 Aug. 2002; US-Patent-Appl-SN-10267099
Report No.(s): AD-D020069; No Copyright; Avail: Other Sources

A method and apparatus are presented for determining turbulent boundary layer thickness. In this method and apparatus, a pair of sensors are mounted to a solid surface interfacing with a fluid at two separate stream wise locations. A voltage output from the pair of sensors is recorded and a real non-dimensional value of a correlation coefficient is computed with measured data from the recorded voltage. A laboratory non- dimensional value of the correlation coefficient is independently determined from laboratory data. The real non-dimensional value is compared with the laboratory non-dimensional value to obtain a boundary layer thickness having a value which minimizes a difference between the values of the real non-dimensional value and the laboratory non-dimensional value.
DTIC
Patent Applications; Turbulent Boundary Layer; Correlation Coefficients

35
INSTRUMENTATION AND PHOTOGRAPHY

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

20030067895 NASA Johnson Space Center, Houston, TX, USA
Evaluation of Human Research Facility Ultrasound With the ISS Video System
Melton, Shannon; Sargsyan, Ashot; August 2003; 20 pp.; In English
Report No.(s): NASA/TP-2003-212056; S-908; NAS 1.60:212056; No Copyright; Avail: CASI; A03, Hardcopy

Most medical equipment on the International Space Station (ISS) is manifested as part of the U.S. or the Russian medical hardware systems. However, certain medical hardware is also available as part of the Human Research Facility. The HRF and the JSC Medical Operations Branch established a Memorandum of Agreement for joint use of certain medical hardware, including the HRF ultrasound system, the only diagnostic imaging device currently manifested to fly on ISS. The outcome of a medical contingency may be changed drastically, or an unnecessary evacuation may be prevented, if clinical decisions are supported by timely and objective diagnostic information. In many higher-probability medical scenarios, diagnostic ultrasound is a first-choice modality or provides significant diagnostic information. Accordingly, the Clinical Care Capability Development Project is evaluating the HRF ultrasound system for its utility in relevant clinical situations on board ISS. For effective management of these ultrasound-supported ISS medical scenarios, the resulting data should be available for viewing and interpretation on the ground, and bidirectional voice communication should be readily available to allow ground experts (sonographers, physicians) to provide guidance to the Crew Medical Officer. It may also be vitally important to have the capability of real-time guidance via video uplink to the CMO-operator during an exam to facilitate the diagnosis in a timely fashion. In this document, we strove to verify that the HRF ultrasound video output is compatible with the ISS video system, identify ISS video system field rates and resolutions that are acceptable for varying clinical scenaiios, and evaluate the HRF ultrasound video with a commercial, off-the-shelf video converter, and compare it with the ISS video system.
Author
International Space Station; Research Facilities; Ultrasonics; Video Tape Recorders; Medical Equipment

20030068061 NASA Glenn Research Center, Cleveland, OH, USA
Reference Gauging System for a Small-Scale Liquid Hydrogen Tank
VanDresar, Neil T.; Siegwarth, James D.; July 2003; 23 pp.; In English
Contract(s)/Grant(s): WBS 22-721-26-11
Report No.(s): NASA/TM-2003-212455; E-13975; NAS 1.15:212455; No Copyright; Avail: CASI; A03, Hardcopy

A system to accurately weigh the fluid contents of a small-scale liquid hydrogen test tank has been experimentally verified. It is intended for use as a reference or benchmark system when testing lowgravity liquid quantity gauging concepts in the terrestrial environment. The reference gauging system has shown a repeatable measurement accuracy of better than 0.5 percent of the full tank liquid weight. With further refinement, the system accuracy can be improved to within 0.10 percent of full scale. This report describes the weighing system design, calibration, and operational results. Suggestions are given for further refinement of the system. An example is given to illustrate additional sources of uncertainty when mass measurements are converted to volume equivalents. Specifications of the companion test tank and its multi-layer insulation system are provided.
Author
Measuring Instruments; Weight (Mass); Liquid Hydrogen

20030068091 Texas Univ. at Dallas, Richardson, TX, USA
Person Identification from Video with Multiple Biometric Cues: Benchmarks for Human and Machine Performance
O'Toole, Alice J.; Jan. 2003; 9 pp.; In English
Contract(s)/Grant(s): GF49620-00-1-0382
Report No.(s): AD-A415169; TR-6300261; AFRL-SR-AR-TR-03-0215; No Copyright; Avail: CASI; A02, Hardcopy
We have compiled a database of images and videos that includes images and videos of approximately 300 human participants. Duplicate sets of images and videos taken from 1 week to 6 months after the first set are available for approximately 200 of these people. The images include 9 standard 'mug shot poses'. The videos include head rotations, dynamic facial expressions, facial speech clips, and 3 whole-body gait clips. Experiments have been completed comparing the effects of several types of facial motion on face recognition, the effects of face familiarity on recognition from video clips taken at a distance, and on the effects of attention on recognition of moving faces. The results of these studies provide insight into the way motion can facilitate or interfere with the encoding of the invariant face and body features that support recognition.
DTIC
Biometrics; Human Performance

20030068100 NASA Glenn Research Center, Cleveland, OH, USA
Microgravity Emissions Laboratory Testing of the Light Microscopy Module Control Box Fan
McNelis, Anne M.; Samorezov, Sergey; Haecker, Anthony H.; July 2003; 13 pp.; In English; Noise-Con 2003, 23-25 Jun. 2003, Cleveland, OH, USA
Contract(s)/Grant(s): WBS-22-400-32-30-03
Report No.(s): NASA/TM-2003-212333; E-13927; NAS 1.15:212333; No Copyright; Avail: CASI; A03, Hardcopy
The Microgravity Emissions Laboratory (MEL) was developed at the NASA Glenn Research Center for the characterization, simulation, and verification of the International Space Station (ISS) microgravity environment. This Glenn lab was developed in support of the Fluids and Combustion Facility (FCF). The MEL is a six-degrees-of-freedom inertial measurement system that can characterize the inertial response forces (emissions) of components, subrack payloads, or rack-level payloads down to 10 7g. The inertial force output data generated from the steady-state or transient operations of the test article are used with finite element analysis, statistical energy analysis, and other analysis tools to predict the on-orbit environment at specific science or rack interface locations. Customers of the MEL have used benefits in isolation performance testing in defining available attenuation during the engineering hardware design phase of their experiment s development. The Light Microscopy Module (LMM) Control Box (LCB) fan was tested in the MEL in June and July of 2002. The LMM is planned as a remotely controllable on-orbit microscope subrack facility that will be accommodated in an FCF Fluids Integrated Rack on the ISS. The disturbances measured in the MEL test resulted from operation of the air-circulation fan within the LCB. The objectives of the testing were (1) to identify an isolator to be added to the LCB fan assembly to reduce fan-speed harmonics and (2) to identify the fan-disturbance forcing functions for use in rack-response analysis of the LMM and Fluids Integrated Rack facility. This report describes the MEL, the testing process, and the results from ground-based MEL LCB fan testing.
Author
Inertia; Microscopes; Fans; Microgravity

20030068114 NASA Marshall Space Flight Center, Huntsville, AL, USA
Composition of the Chandra ACIS Contaminant
Marshall, Herman; Tennant, Allyn; Grant, Catherine; Hitchcock, Adam; ODell, Steve; Plucinsky, Paul; [2003]; 2 pp.; In

English; X-Ray and Gamma-Ray Instrumentation for Astronomy XIII, 3-8 Aug. 2003, San Diego, CA, USA; No Copyright; Avail: Other Sources; Abstract Only

The Advanced CCD Imaging Spectrometer (ACIS) on the Chandra X-ray Observatory is suffering a gradual loss of low energy sensitivity due to a buildup of a contaminant. High resolution spectra of bright astrophysical sources using the Chandra Low Energy Transmission Grating Spectrometer (LETGS) have been analyzed in order to determine the nature of the contaminant by measuring the absorption edges. The dominant element in the contaminant is carbon. Edges due to oxygen and fluorine are also detectable. We can place stringent limits on nitrogen and high Z elements such as AI, Si, and Mg. Not including H, we find that C, O, and F comprise less than 80%, 7%, and 7% of the contaminant by number, respectively, Nitrogen is less than 3% of the contaminant. We will assess various candidates for the contaminating material and the time dependence. For example, the detailed structure of the absorption edges provides information about the bonding structure of the compound, eliminating aromatic hydrocarbons as the contaminating material.

Author

Contaminants; Imaging Spectrometers; Losses; High Resolution

20030068133 NASA Marshall Space Flight Center, Huntsville, AL, USA

ATIC Experiment: Preliminary Results from the Flight in 2002

Ahn, H. S.; Adams, J. H.; Bashindzhagyan, G.; Batkov, K. E.; Chang, J.; Christl, M.; Cox, M.; Ellison, S. B.; Fazely, A. R.; Ganel, O.; [2003]; 1 pp.; In English; 28th International Cosmic Ray Conference, 31 Jul. - 7 Aug. 2003, Tsukuba, Japan; Copyright; Avail: Other Sources; Abstract Only

Abstract The Advanced Thin Ionization Calorimeter (ATIC) had successful Long Duration Balloon flights from McMurdo, Antarctica in both 2000 and 2002. The instrument consists of a Silicon matrix for charge measurement, a flared graphite target to induce nuclear interactions, scintillator strip hodoscopes for triggering and helping reconstruct trajectory, and a BGO calorimeter to measure the energy of incident particles. In this paper, we discuss the second flight, which lasted 20 days, starting on 12/29/02. Preliminary results from the on-going analysis of the data including the proton and helium spectra are reported.

Author

Calorimeters; Scintillation Counters; Protons; Nuclear Interactions; Particle Energy

20030068136 NASA Marshall Space Flight Center, Huntsville, AL, USA

High Accuracy Thermal Expansion Measurement At Cryogenic Temperatures

Stallcup, Michael; Presson, Joan; Tucker, James; Daspit, Gregory; Nein, Max; [2003]; 1 pp.; In English; SPIE Optical Science and Technology Conference, 3-8 Aug. 2003, San Diego, CA, USA

Contract(s)/Grant(s): NASA Order H-35206D; No Copyright; Avail: Other Sources; Abstract Only

A new, interferometer based system for measuring thermal expansion to an absolute accuracy of 20 ppb or better at cryogenic temperatures has been developed. Data from NIST Copper SRM 736 measured from room temperature to 15 K will be presented along with data from many other materials including beryllium, ULE, Zerodur, and composite materials. Particular attention will be given to a study by the Space Optics Manufacturing Technology Center (SOMTC) investigating the variability of ULE and beryllium materials used in the AMSD program. Approximately 20 samples of each material, tested from room temperature to below 30 K are compared as a function of billet location.

Author

Accuracy; Thermal Expansion; Cryogenic Temperature; Interferometers

20030068137 NASA Marshall Space Flight Center, Huntsville, AL, USA

NUCLEON Satellite Mission. Status and Plans

Bashindzhagyan, G.; Adams, J.; Bashindzhagyan, P.; Baranova, N.; Christl, M.; Chilingarian, A.; Chupin, I.; Derrickson, J.; Drury, L.; Egorov, N., et al.; [2003]; 1 pp.; In English; 28th International Cosmic Ray Conference, 31 Jul. - 7 Aug. 2003, Tsukuba, Japan; No Copyright; Avail: Other Sources; Abstract Only

The main objective of the NUCLEON satellite mission is direct measurements of the elemental energy spectra of high-energy (10(exp 11) - 10(exp 15) eV) cosmic rays with Kinematic Lightweight Energy Meter (KLEM) device. The design of the instrument has been corrected to increase geometry factor and improve charge resolution. The special mechanical and electronic systems have been developed for installation of the experimental apparatus in a regular Russian satellite. It is planned to launch the NUCLEON instrument in 2006.

Author

Energy Spectra; Cosmic Rays; Electromagnetic Measurement

20030068142 NASA Glenn Research Center, Cleveland, OH, USA

Overview of Mount Washington Icing Sensors Project

Ryerson, Charles C.; Politovich, Marcia K.; Rancourt, Kenneth L.; Koenig, George G.; Reinking, Roger F.; Miller, Dean R.; July 2003; 16 pp.; In English; 38th Aerospace Sciences Meeting and Exhibit, 10-13 Jan. 2000, Reno, NV, USA

Contract(s)/Grant(s): WBS 22-708-20-03

Report No.(s): NASA/TM-2003-212453; E-13961; NAS 1.15:212453; AIAA Paper 2000-0488; No Copyright; Avail: CASI; A03, Hardcopy

NASA, the FAA, the Department of Defense, the National Center for Atmospheric Research and NOAA are developing techniques for retrieving cloud microphysical properties from a variety of remote sensing technologies. The intent is to predict aircraft icing conditions ahead of aircraft. The Mount Washington Icing Sensors Project MWISP), conducted in April, 1999 at Mt. Washington, NH, was organized to evaluate technologies for the prediction of icing conditions ahead of aircraft in a natural environment, and to characterize icing cloud and drizzle environments. April was selected for operations because the Summit is typically in cloud, generally has frequent freezing precipitation in spring, and the clouds have high liquid water contents. Remote sensing equipment, consisting of radars, radiometers and a lidar, was placed at the base of the mountain, and probes measuring cloud particles, and a radiometer, were operated from the Summit. NASA s Twin Otter research aircraft also conducted six missions over the site. Operations spanned the entire month of April, which was dominated by wrap-around moisture from a low pressure center stalled off the coast of Labrador providing persistent upslope clouds with relatively high liquid water contents and mixed phase conditions. Preliminary assessments indicate excellent results from the lidar, radar polarimetry, radiosondes and summit and aircraft measurements.

Author

Aircraft Icing; Remote Sensing; Prediction Analysis Techniques

20030068322 NASA Langley Research Center, Hampton, VA, USA, Old Dominion Univ., Norfolk, VA, USA

Development of a High Accuracy Angular Measurement System for Langley Research Center Hypersonic Wind Tunnel Facilities

Newman, Brett; Yu, Si-bok; Rhew, Ray D., Technical Monitor; August 2003; 113 pp.; In English

Contract(s)/Grant(s): RTOP 718-20-01-01

Report No.(s): NASA/CR-2003-212401; L-14635; NAS 1.26:212401; No Copyright; Avail: CASI; A06, Hardcopy

Modern experimental and test activities demand innovative and adaptable procedures to maximize data content and quality while working within severely constrained budgetary and facility resource environments. This report describes development of a high accuracy angular measurement capability for NASA Langley Research Center hypersonic wind tunnel facilities to overcome these deficiencies. Specifically, utilization of micro-electro-mechanical sensors including accelerometers and gyros, coupled with software driven data acquisition hardware, integrated within a prototype measurement system, is considered. Development methodology addresses basic design requirements formulated from wind tunnel facility constraints and current operating procedures, as well as engineering and scientific test objectives. Description of the analytical framework governing relationships between time dependent multi-axis acceleration and angular rate sensor data and the desired three dimensional Eulerian angular state of the test model is given. Calibration procedures for identifying and estimating critical parameters in the sensor hardware is also addressed.

Author

Accelerometers; Hypersonic Wind Tunnels; Angular Velocity; Gyroscopes; Data Acquisition

20030068424 Carnegie Institution of Washington, Washington, DC, USA

Acquisition of a High Resolution Field Emission Scanning Electron Microscope for the Analysis of Returned Samples

Nittler, Larry R.; [2003]; 1 pp.; In English

Contract(s)/Grant(s): NAG5-11900; No Copyright; Avail: Other Sources; Abstract Only

This grant furnished funds to purchase a state-of-the-art scanning electron microscope (SEM) to support our analytical facilities for extraterrestrial samples. After evaluating several instruments, we purchased a JEOL 6500F thermal field emission SEM with the following analytical accessories: EDAX energy-dispersive x-ray analysis system with fully automated control of instrument and sample stage; EDAX LEXS wavelength-dispersive x-ray spectrometer for high sensitivity light-element analysis; EDAX/TSL electron backscatter diffraction (EBSD) system with software for phase identification and crystal orientation mapping; Robinson backscatter electron detector; and an in situ micro-manipulator (Kleindiek). The total price was $550,000 (with $150,000 of the purchase supported by Carnegie institution matching funds). The microscope was delivered in October 2002, and most of the analytical accessories were installed by January 2003. With the exception of the wavelength

spectrometer (which has been undergoing design changes) everything is working well and the SEM is in routine use in our laboratory.
Author
Scanning Electron Microscopy; Extraterrestrial Matter; X Ray Spectrometers; Sensitivity Analysis

20030068502 NASA Marshall Space Flight Center, Huntsville, AL, USA
A Biodosimeter for Multiparametric Determination of Radiation Dose, Radiation Quality, and Radiation Risk
Richmond, Robert; Cruz, Angela; Jansen, Heather; Bors, Karen; [2003]; 1 pp.; In English; World Congress on Medical Physics and Biomedical Engineering, 24-29 Aug. 2003, Sydney, Australia; No Copyright; Avail: Other Sources; Abstract Only

Predicting risk of human cancer following exposure of an individual or a population to ionizing radiation is challenging. To an approximation, this is because uncertainties of uniform absorption of dose and the uniform processing of dose-related damage at the cellular level within a complex set of biological variables degrade the confidence of predicting the delayed expression of cancer as a relatively rare event. Cellular biodosimeters that simultaneously report: 1) the quantity of absorbed dose after exposure to ionizing radiation, 2) the quality of radiation delivering that dose, and 3) the risk of developing cancer by the cells absorbing that dose would therefore be useful. An approach to such a multiparametric biodosimeter will be reported. This is the demonstration of a dose responsive field effect of enhanced expression of keratin 18 (K18) in cultures of human mammary epithelial cells irradiated with cesium-1 37 gamma-rays. Dose response of enhanced K18 expression was experimentally extended over a range of 30 to 90 cGy for cells evaluated at mid-log phase. K18 has been reported to be a marker for tumor staging and for apoptosis, and thereby serves as an example of a potential marker for cancer risk, where the reality of such predictive value would require additional experimental development. Since observed radiogenic increase in expression of K18 is a field effect, ie., chronically present in all cells of the irradiated population, it may be hypothesized that K18 expression in specific cells absorbing particulate irradiation, such as the high-LET-producing atomic nuclei of space radiation, will report on both the single-cell distributions of those particles amongst cells within the exposed population, and that the relatively high dose per cell delivered by densely ionizing tracks of those intersecting particles will lead to cell-specific high-expression levels of K18, thereby providing analytical end points that may be used to resolve both the quantity and the quality of the radiation dose absorbed by individual cells. The principal value of this reported potential multiparametric cellular biodosimeter is suggested to be that it justifies a search for similar but more robust radiogenic assays. That is, K18 is only one radiation dose-sensitive expressed protein, whereas analytical techniques of genomics and proteomics can be used to simultaneously analyze multiple gene and protein expressions resulting from radiation-dose absorption. The potential usefulness of multiparametric cellular biodosimeters will be best realized from quantitatively profiling these multiple markers using these modern techniques.
Author
Dosimeters; Radiation Dosage; Radiation Absorption; Risk

20030068552 Manchester Univ., MacClesfield, UK
New Diamond Coated Carbide Dental Bur in Operation
Sein, Htet; Jackson, Mark; Polini, Ricardo; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 234-243; In English; See also 20030068525; Original contains color and black and white illustrations; No Copyright; Avail: CASI; A02, Hardcopy

Depositions of hot filament chemical vapor deposited (HFCVD) diamond on cobalt-cemented tungsten carbide (WC-Co) rotary cutting dental burs are presented. Conventional dental tools made of sintered polycrystalline diamond (PCD) have a number of problems associated with heterogeneity of the crystallite, decreased cutting efficiency and short life. A preferential (111) faceted diamond has been obtained after 15 hours deposition at a growth rate of 1.1 micron/hr. Diamond coated WC-Co dental burs and conventional sintered burs are mainly used in turning, milling and drilling operation for machining metal ceramic hard alloys such as cobalt-chrome, composite teeth and aluminum alloy in dental laboratory. The influence of structure, mechanical characteristics of both diamond grains and hard alloys on the wear behavior as well as the regime of grinding on diamond wear are considered. Erosion wear properties are also investigated under air-sand erosion testing method. After machining with excessive cutting performance, calculations can be made on flank and crater wears areas. Diamond coated WC-Co dental bur offered significantly better erosion and wear resistance compared to uncoated WC-Co tools and sintered burs.
Author
Dentistry; Medical Equipment; Drill Bits; Diamonds; Tungsten Carbides; Coatings

20030068582 North Carolina Univ., Chapel Hill, NC, USA

Development of CNT Based Field Emission X-Ray Source And Imaging System For Biomedical And Industrial Applications

Zhou, Otto; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 3; In English; See also 20030068525; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

X-ray radiation is widely used for medical and industrial imaging applications. Current x- ray tubes use thermionic cathodes to produce the electron beams which bombard on metal targets to generate x ray. The design has several intrinsic limitations. In this talk we demonstrate that diagnostic x-ray radiation can be generated using a carbon nanotube based field emission cathode. The device can readily produce both continue and pulsed x-ray with a programmable waveform and repetition rate. The x-ray intensity is sufficient to image human extremity. Pulsed x-ray with a repetition rate greater than 100 kHz was readily achieved by programming the gate voltage. The performance of this cold-cathode x-ray tube will be discussed and compared with the conventional thermionic systems. We will also present imaging systems/modalities enabled by the field emission x-ray source.

Author

X Ray Sources; Imaging Techniques; Cold Cathodes

20030068692 Surrey Univ., Guildford, UK

Calibration of the Measurement of SP(Sup 2)-Type Bonding in Carbon Using EEELS in an Electron Microscope

Stolojan, V.; Goringe, M. J.; Deane, J. H. B.; Ravi, S.; Silva, P.; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 500-505; In English; See also 20030068525

Contract(s)/Grant(s): EPSRC-GR/N36073/01; No Copyright; Avail: CASI; A02, Hardcopy

Electron Energy Loss Spectroscopy (EELS) in an electron microscope is an accurate method for the measurement of the sp(sup 2)-type bonding in carbon, due to the presence of a clearly defined sharp peak in the specific carbon K spectral edge, whose area is directly proportional to the number of empty states in the local density of states. However, an absolute measurement of sp(sup 2) bonds requires to be scaled to the total number of sp(sup 2) and sp(sup 3) bonded atoms and then normalized to a 100% sp(sup 2)-bonded standard. Usually, pure graphite is used as a 100% sp(sup 2)- bonded standard. However, this normalizing value is affected by the anisotropy of the empty states, as their excitation probability depends on the amount of momentum that is transferred by the incident electron beam in the direction of the empty states, which is orientation dependent. Here we review the theoretical prediction of a magic angle for an electron microscope, when sp(sup 2) measurements are independent of the experimental conditions and support it with experimental verification. Furthermore, we analyze the implications of anisotropy on the measurements of the sp(sup 2)-type bonding in amorphous carbon samples and in carbon nanotubes.

Author

Calibrating; Measurement; Bonding; Carbon; Amorphous Materials

20030068820 National Advisory Committee for Aeronautics. Langley Aeronautical Lab., Langley Field, VA, USA

Development and Construction of an Interferometer for Optical Measurements of Density Fields

Zobel, Th.; September 1947; 34 pp.; In English; Original contains black and white illustrations

Report No.(s): NACA-TM-1184; No Copyright; Avail: CASI; A03, Hardcopy

A method of interference is described in the present report which promises profitable application in aeronautical research. The physical foundation of the method and a simple method of adjustment are briefly discussed. The special technical construction of the instrument is described which guarantees its use also in the case of vibrations of the surrounding space and permits the investigation of unsteady phenomena. It is found that the interference method will make the small differences in density in the flow field around the body even at low speeds. (40 m/sec) optically measurable.

Author

Interferometers; Optical Measurement; Density Measurement

20030068840 NASA Langley Research Center, Hampton, VA, USA

Edge Triggered Apparatus and Method for Measuring Strain in Bragg Gratings

Froggatt, Mark E., Inventor; May 20, 2003; 9 pp.; In English

Patent Info.: Filed 24 Mar. 2000; No Copyright; Avail: CASI; A02, Hardcopy

An apparatus and method for measuring strain of gratings written into an optical fiber. Optical radiation is transmitted over one or more contiguous predetermined wavelength ranges into a reference optical fiber network and an optical fiber network under test to produce a plurality of reference interference fringes and measurement interference fringes, respectively. The reference and measurement fringes are detected, and the reference fringes trigger the sampling of the measurement fringes. This results in the measurement fringes being sampled at 2(pi) increments of the reference fringes. Each sampled measurement fringe of each wavelength sweep is transformed into a spatial domain waveform. The spatial domain waveforms are summed to form a summation spatial domain waveform that is used to determine location of each grating with respect to a reference reflector. A portion of each spatial domain waveform that corresponds to a particular grating is determined and transformed into a corresponding frequency spectrum representation. The strain on the grating at each wavelength of optical radiation is determined by determining the difference between the current wavelength and an earlier, zero-strain wavelength measurement.
Official Gazette of the U.S. Patent and Trademark Office
Bragg Gratings; Frequency Distribution; Optical Properties; Radiation Spectra; Strain Measurement

20030068895 NASA Glenn Research Center, Cleveland, OH, USA
Capacitive Extensometer
Perusek, Gail P., Inventor; June 24, 2003; 21 pp.; In English
Patent Info.: Filed 7 May 2001; US-Patent-6,581,481; US-Patent-Appl-SN-853920; NASA-Case-LEW-16638-2; No Copyright; Avail: CASI; A03, Hardcopy

The present invention provides for measurements of the principal strain magnitudes and directions, and maximum shear strain that occurs in a porous specimen, such as plastic, ceramic or porous metal, when it is loaded (or subjected to a load). In one embodiment the invention includes a capacitive delta extensometer arranged with six sensors in a three piece configuration, with each sensor of each pair spaced apart from each other by a predetermined angle, such as 120 degrees.
Official Gazette of the U.S. Patent and Trademark Office
Capacitance; Extensometers; Magnitude; Porosity; Shear Strain

20030068909 NASA Stennis Space Center, Bay Saint Louis, MS, USA
Radiant Temperature Nulling Radiometer
Ryan, Robert, Inventor; July 1, 2003; 13 pp.; In English
Patent Info.: Filed 4 May 2001; US-Patent-6,585,410; US-Patent-Appl-SN-849945; NASA-Case-SSC-00124; No Copyright; Avail: CASI; A03, Hardcopy

A self-calibrating nulling radiometer for non-contact temperature measurement of an object, such as a body of water, employs a black body source as a temperature reference, an optomechanical mechanism, e.g., a chopper, to switch back and forth between measuring the temperature of the black body source and that of a test source, and an infrared detection technique. The radiometer functions by measuring radiance of both the test and the reference black body sources; adjusting the temperature of the reference black body so that its radiance is equivalent to the test source; and, measuring the temperature of the reference black body at this point using a precision contact-type temperature sensor, to determine the radiative temperature of the test source. The radiation from both sources is detected by an infrared detector that converts the detected radiation to an electrical signal that is fed with a chopper reference signal to an error signal generator, such as a synchronous detector, that creates a precision rectified signal that is approximately proportional to the difference between the temperature of the reference black body and that of the test infrared source. This error signal is then used in a feedback loop to adjust the reference black body temperature until it equals that of the test source, at which point the error signal is nulled to zero. The chopper mechanism operates at one or more Hertz allowing minimization of l/f noise. It also provides pure chopping between the black body and the test source and allows continuous measurements.
Official Gazette of the U.S. Patent and Trademark Office
Body Temperature; Infrared Radiation; Radiometers; Infrared Detectors

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*.

20030067778 Arizona Univ., Tucson, AZ
High Power Femtosecond Laser Light Strings
Moloney, J. V.; Feb. 28, 2003; 6 pp.; In English
Contract(s)/Grant(s): F49620-00-1-0312
Report No.(s): AD-A414766; AFRL-SR-AR-TR-03-0168; No Copyright; Avail: CASI; A02, Hardcopy

This project funded for 2.5 years, focused on the modeling of high power femtosecond pulse propagation in air. The work has been very successful and has received a broad exposure amongst academic, industry and DOD communities. Potential applications abound for light strings and the RF electromagnetic pulses emitted from plasma channels generated by these light strings. A number of papers have been published in the literature and others are submitted or in preparation.
DTIC
High Power Lasers; Laser Outputs; Emittance

20030067820 NASA Marshall Space Flight Center, Huntsville, AL, USA
Thermal Property Measurement of Semiconductor Melt using Modified Laser Flash Method
Lin, Bochuan; Zhu, Shen; Ban, Heng; Li, Chao; Scripa, Rosalla N.; Su, Ching-Hua; Lehoczky, Sandor L.; [2003]; 1 pp.; In English; American Society of Mechanical Engineers Heat Transfer Conference, 21-23 Jul. 2003, Las Vegas, NV, USA
Contract(s)/Grant(s): NCC8-66
Report No.(s): HT2003-40448; Copyright; Avail: Other Sources

This study further developed standard laser flash method to measure multiple thermal properties of semiconductor melts. The modified method can determine thermal diffusivity, thermal conductivity, and specific heat capacity of the melt simultaneously. The transient heat transfer process in the melt and its quartz container was numerically studied in detail. A fitting procedure based on numerical simulation results and the least root-mean-square error fitting to the experimental data was used to extract the values of specific heat capacity, thermal conductivity and thermal diffusivity. This modified method is a step forward from the standard laser flash method, which is usually used to measure thermal diffusivity of solids. The result for tellurium (Te) at 873 K: specific heat capacity 300.2 Joules per kilogram K, thermal conductivity 3.50 Watts per meter K, thermal diffusivity 2.04 x 10(exp -6) square meters per second, are within the range reported in literature. The uncertainty analysis showed the quantitative effect of sample geometry, transient temperature measured, and the energy of the laser pulse.
Author
Melts (Crystal Growth); Semiconductors (Materials); Thermodynamic Properties; Laser Applications

20030068556 Academy of Sciences (USSR), Moscow, USSR
Excimer Laser Annealing of Diamonds Implanted with Light Ions
Pimenov, S. M.; Kononenko, V. V.; Kononenko, T. V.; Konov, V. I.; Fischer, P.; Romano, V.; Weber, H. P.; Khomich, A. V.; Khmelnitskiy, R. A.; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 303-308; In English; See also 20030068525; Original contains color and black and white illustrations
Contract(s)/Grant(s): SNSF-7SUPJ062184; SNSF-7IP62635; No Copyright; Avail: CASI; A02, Hardcopy

In this paper the results of studies on annealing/graphitization/ablation processes induced in ion-implanted diamond layers by nanosecond pulse irradiation with KrF excimer laser (lambda=248 nm, tau=15 ns) are reported. The deeply buried damaged layers in diamond single crystals are produced by implantation with hydrogen, deuterium, and helium ions of 350 keV energy. It is shown that the non-linear depth distribution of radiation defects is a factor which strongly influences the character of laser-induced processes in the ion-implanted layers. Particularly, the annealing/graphitization behavior is found to be very different for irradiation conditions when a laser beam is incident on the ion-implanted surface with low defect density or, passing through diamond, onto the buried layer with high defect density. In the latter case, the annealing of radiation damage is much more efficient and graphitization in the deeply buried layers is inhibited. Based on white-light-interferometry examination of laserirradiated surface (with sub-nanometer resolution) and optical transmission in laser spots, peculiarities of

laser annealing and graphitization in diamonds implanted to different doses are demonstrated and discussed.
Author
Excimer Lasers; Laser Annealing; Diamonds; Ion Implantation; Light Ions; Graphitization; Ablation

20030068693 Mie Univ., Tsu, Japan
Synthesis and Some Properties of Polyhedral Graphite
Kokai, Fumio; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 523; In English; See also 20030068525; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

We have applied laser vaporization to grow carbon materials and describe a novel synthesis of polyhedral graphite (PG) particles. This synthesis is based on the condensation of carbon vapor confined by high-pressure Ar gas. We used a CO2 laser (10.6 micrometer and 5-kilowatt peak power) with a pulse duration of 500 ms. The laser beam was focused onto a graphite target through a ZnSe window in a cylindrical stainless-steel chamber filled with Ar gas at 8 x 10(exp 5) Pa. The laser spot size and power density on the target were adjusted to 2 millimeters and 30 kilowatts per square centimeter, respectively. After laser irradiation of several shots on the fresh surface of a rotating graphite target, the deposits produced on the chamber wall were collected. SEM, TEM, Raman scattering spectroscopy, and powder XRD investigation of the deposited particles demonstrated that this laser vaporization method produces PG with a high yield (greater than 90%) and without hollow cavities in their centers. Faceted PG particles, ranging in size from 110 to 500 nm, have a turbostatic structure. Studies on the structure and properties, such as electrical resistance, of PG particles during high-pressure compression of the PG particles is underway.
Author
Graphite; Synthesis (Chemistry); Surface Properties; Vaporizing; Laser Applications

20030068924 Texas Univ., Austin, TX, USA
Laser Velocimeter for Studies of Microgravity Combustion Flowfields
Varghese, Philip L.; August 30, 2003; 34 pp.; In English
Contract(s)/Grant(s): NAG3-2240; No Copyright; Avail: CASI; A03, Hardcopy

A velocimeter was developed based on modulated filtered Rayleigh scattering (MFRS). The MFRS velocimeter was successfully demonstrated by making one-component velocity measurements in a supersonic expansion using molecular Rayleigh scattering in a jet of N2. These measurements were made in a sweep mode where the Rayleigh scattered profile is cross-correlated with absorption in a static cell to determine velocity. To improve temporal resolution the frequency-locked mode of operation was developed, with an in-situ referencing scheme to compensate for signal fluctuations arising from density variations in the probe volume. Spectroscopic grade (i.e. continuously tunable, single-mode) laser sources with high power (greater than 100 mW) are not commercially available at the wavelength of interest (780 nm). We developed an all-solid-state system with a low power (approximately 10 mW) spectroscopic grade laser source in a Littrow cavity is amplified by a broad-area diode laser. We have demonstrated that the slaved output tracks the injected input but have not yet demonstrated power gain by the end of the grant period.
Author
Combustion; Flow Distribution; Laser Doppler Velocimeters; Microgravity; Velocity Measurement

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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*.

20030067732 State Univ. of New York, Stony Brook, NY, USA
Optimizing Functionally Graded Materials to Resist Failure under Dynamic Loadings
Nakamura, Toshio; Nov. 25, 2002; 13 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): DAAD19-99-1-0318
Report No.(s): AD-A414727; ARO-40192.1-EG; No Copyright; Avail: CASI; A03, Hardcopy

After three years of the project, many of the proposed research topics have been completed and manuscripts were submitted for publication. First, for the dynamic crack propagation within functionally graded materials (FGMs), a novel fracture criterion was introduced. It is based on energy concept and controls crack growth rate and associated plastic

dissipation flow. This model was implemented in dynamic failure analysis to investigate crack propagation within elastic plastic graded materials. The new procedure was also implemented for the impact of graded protective layer. The results confirmed the importance of modeling of cracking, revealed the effects of compositional gradation through-thickness. In a subsequent analysis, a procedure that utilizes an inverse analysis was developed to measure key fracture parameters. These parameters are difficult to measure with conventional means. Third, in collaboration with materials science group, material parameters of actual FGM were measured using the indentation and inverse method. The specimens were thermal barrier coatings fabricated with zirconia and NiCrAlY. This type of advanced scheme to post-process experimental data is essential for obtaining properties of complex systems. In addition, preliminary fracture tests were conducted for thicker FGMs to determine its fracture behavior.
DTIC
Finite Element Method; Fracture Mechanics

20030067797
Methods for Automated and Continuous Commissioning of Building Systems
Apr. 2003; 212 pp.; In English
Report No.(s): PB2003-106430; No Copyright; Avail: CASI; A10, Hardcopy

Effective commissioning and maintenance of building systems and equipment extends equipment life, improves or maintains occupant comfort, and improves equipment availability. Conversely, poorly maintained systems and equipment will have shorter lives and will experience more frequent failures, leading to lower levels of equipment availability and greater occupant dissatisfaction. Currently, effective commissioning, ongoing manual maintenance, and recommissioning can be expensive. To address this issue, the Air Conditioning and Refrigeration Technology Institute (ARTI) launched an investigation into methods for automating the continuous commissioning of building systems. The overall goal of this project is to develop methods for improving the commissioning and maintenance of HVAC systems and equipment through automation. To achieve this, the project was broken down into five tasks.
NTIS
Air Conditioning; Maintenance; Refrigerating; Automatic Control

20030068124 NASA Marshall Space Flight Center, Huntsville, AL, USA
Thermo-Mechanical Modeling and Analysis for Turbopump Assemblies
Platt, Mike; Marsh, Matt; July 15, 2003; 16 pp.; In English; 14th Annual Thermal and Fluids Analysis Workshop, 18-22 Aug. 2003, Hampton, VA, USA
Contract(s)/Grant(s): NAS8-02019; No Copyright; Avail: CASI; A03, Hardcopy

Life, reliability, and cost are strongly impacted by steady and transient thermo-mechanical effect. Design cycle can suffer big setbacks when working a transient stress/deflection issue. Balance between objectives and constrains is always difficult. Requires assembly-level analysis early in the design cycle.
Derived from text
Thermodynamics; Turbine Pumps; Life (Durability)

20030068294 NASA Glenn Research Center, Cleveland, OH, USA
Unbalance Response Prediction for Rotors on Ball Bearings Using Speed and Load Dependent Nonlinear Bearing Stiffness
Fleming, David P.; Poplawski, J. V.; August 2003; 14 pp.; In English; Second International Symposium on Stability Control of Rotating Machinery, 4-8 Aug. 2003, Gdansk, Poland
Contract(s)/Grant(s): WBS 22-714-08-11
Report No.(s): NASA/TM-2003-212527; E-14089; NAS 1.15:212527; No Copyright; Avail: CASI; A03, Hardcopy

Rolling-element bearing forces vary nonlinearly with bearing deflection. Thus an accurate rotordynamic analysis requires that bearing forces corresponding to the actual bearing deflection be utilized. For this work bearing forces were calculated by COBRA-AHS, a recently developed rolling-element bearing analysis code. Bearing stiffness was found to be a strong function of bearing deflection, with higher deflection producing markedly higher stiffness. Curves fitted to the bearing data for a range of speeds and loads were supplied to a flexible rotor unbalance response analysis. The rotordynamic analysis showed that vibration response varied nonlinearly with the amount of rotor imbalance. Moreover, the increase in stiffness as critical speeds were approached caused a large increase in rotor and bearing vibration amplitude over part of the speed range compared to the case of constant bearing stiffness. Regions of bistable operation were possible, in which the amplitude at a given speed

was much larger during rotor acceleration than during deceleration. A moderate amount of damping will eliminate the bistable region, but this damping is not inherent in ball bearings.
Author
Ball Bearings; Balance; Rotors; Predictions; Responses; Rotor Dynamics

20030068314 NASA Ames Research Center, Moffett Field, CA, USA
Masked Proportional Routing
Wolpert, David H., Inventor; June 10, 2003; 15 pp.; In English
Patent Info.: Filed 5 Aug. 1999; US-Patent-6,577,601; US-Patent-Appl-SN-369380; NASA-Case-ARC-14366-1; No Copyright; Avail: CASI; A03, Hardcopy

Distributed approach for determining a path connecting adjacent network nodes, for probabilistically or deterministically transporting an entity, with entity characteristic mu from a source node to a destination node. Each node i is directly connected to an arbitrary number J(mu) of nodes, labeled or numbered j=jl, j2, ... jJ(mu). In a deterministic version, a J(mu)-component baseline proportion vector p(i;mu) is associated with node i. A J(mu)-component applied proportion vector p*(i;mu) is determined from p(i;mu) to preclude an entity visiting a node more than once. Third and fourth J(mu)-component vectors, with components iteratively determined by Target(i;n(mu);mu),=alpha(mu).Target(i;n(mu)-1;mu)j+beta(mu).p* (i;mu)j and Actual(i;n(mu);+a(mu)j. Actual(i;n(mu)-l;mu)j+beta(mu).Sent(i;j'(mu);n(mu)-1;mu)j, are computed, where n(mu) is an entity sequence index and alpha(mu) and beta(mu) are selected numbers. In one embodiment, at each node i, the node j=j'(mu) with the largest vector component difference, Target(i;n(mu);mu)j'- Actual (i;n(mu);mu)j'. is chosen for the next link for entity transport, except in special gap circumstances, where the same link is optionally used for transporting consecutively arriving entities. The network nodes may be computer-controlled routers that switch collections of packets, frames, cells or other information units. Alternatively, the nodes may be waypoints for movement of physical items in a network or for transformation of a physical item. The nodes may be states of an entity undergoing state transitions, where allowed transitions are specified by the network and/or the destination node.
Official Gazette of the U.S. Patent and Trademark Office
Connectors; Communication Networks; Probability Theory; Nodes (Standing Waves)

20030068316 NASA Marshall Space Flight Center, Huntsville, AL, USA
Gasket Assembly for Sealing Mating Surfaces
Bryant, Melvin A., III, Inventor; June 17, 2003; 6 pp.; In English
Patent Info.: Filed 16 Oct. 2000; No Copyright; Avail: CASI; A02, Hardcopy

A pair of substantially opposed mating surfaces are joined to each other and sealed in place by means of an electrically-conductive member which is placed in proximity to the mating surfaces. The electrically-conductive member has at least one element secured thereto which is positioned to contact the mating surfaces, and which softens when the electrically-conductive member is heated by passing an electric current therethrough. The softened element conforms to the mating surfaces, and upon cooling of the softened element the mating surfaces are joined together in an effective seal. Of particular significance is an embodiment of the electrically-conductive member which is a gasket having an electrically-conductive gasket base and a pair of the elements secured to opposite sides of the gasket base. This embodiment is positioned between the opposed mating surfaces to be joined to each other. Also significant is an embodiment of the electrically-conductive member which is an electrically-conductive sleeve having an element secured to its inner surface. This embodiment surrounds cylindrical members the bases of which are the substantially opposed mating surfaces to be joined, and the element on the inner surface of the sleeve contacts the outer surfaces of the cylindrical members.
Author
Gaskets; Sealing; Bonding

20030068535 Nippon Inst. of Tech., Japan
Tribological Performance of Cr-Containing DLC Films
Kotake, Katsuyuki; Miyake, Shojiro; Watanabe, Shuichi; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 447-450; In English; See also 20030068525; No Copyright; Avail: CASI; A01, Hardcopy

Diamond-Like-Carbon films have been widely recognized as being a wear-resistant solid lubricant with a low friction coefficient. Recently, there have been many attempts to improve the tribological behavior of DLC films by the addition of various metals. In this study, in order to apply for severe sliding conditions, for example, for auto-motive parts, etc.,

tribological performance of Cr-containing DLC films has been investigated. Cr-containing DLC films were deposited by means of an ion-plating having electrical resist-heating unit for Cr vaporization. The reactive evaporation between C vapor using electron-beam and Cr vapor has been carried out under various plasma-gas conditions. DLC films were also prepared using same ion-plating for comparison. Tribological performances of the films were demonstrated by means of a ball-on-disk tribometer under various lubricating environments. Friction coefficient of Cr-DLC film is lower than that of DLC film under oil lubrication with appropriate additives.
Author
Solid Lubricants; Wear Resistance; Diamond Films; Ion Plating; Chromium

20030068550 Nippon Inst. of Tech., Japan
Microcutting of Duralumin Using Focused-Ion-Beam-Processed Profile Cutting Diamond Bites
Noguchi, Hiroyuki; Takeuchi, Sadao; Murakawa, Masao; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 213-217; In English; See also 20030068525; Original contains color and black and white illustrations; No Copyright; Avail: CASI; A01, Hardcopy

Single-crystal diamond bites can be used for ultrahigh-precision cutting of noniron metal materials because diamond has high hardness, stiffness and wear resistance. However, the diamond bite itself is processed using microdiamond particles, thus the shapes of the bite are limited to those using straight lines and simple circular arcs. In recent years, since the spot diameter of the iron beam of focused ion beam (FIB) devices has been reduced substantially, nanosize processing of various materials has become possible. In microcutting, it is possible to manufacture fine axes by sharpening blade edges and reducing cutting resistance. On the basis of this observation, we applied FIB to the finishing and shaping of the cutting edge of diamond bites. Using FIB-processed diamond bites, we manufactured a microshaft of 5 m diameter by lathe turning of duralumin. Furthermore, using a diamond tool whose edge had been sharpened by FIB, we succeeded in producing a highly accurate notch with 3 m depth in the microshaft.
Author
Diamonds; Metal Ions; Ion Beams; Lathes; Micromachining

20030068565 Tokyo Inst. of Tech., Tokyo, Japan
Application of DLC Coated Dies to Variable Shape Extrusion of Aluminum Square Pipes
Ohtake, Naoto; Horita, Ko-Ichi; Yamagata, Akira; Hara, Kaoru; Proceedings of the Seventh Applied Diamond Conference/ Third Frontier Carbon Technology Joint Conference; August 2003, pp. 478-483; In English; See also 20030068525; Original contains black and white illustrations; No Copyright; Avail: CASI; A02, Hardcopy

An aluminum space frame s one of the candidates to be applies to a structure of car bodies in near future because of its lightweight as well as high strength. To omit the secondary forming process in the production of an aluminum space frame, a variable shape extrusion apparatus with either a taper mandrel or a step mandrel and four movable dies was developed, and experiments to investigate the characteristics of hot extrusion were conducted by using the apparatus. Results from the experiments suggest that the step mandrel provides good dimensional accuracy due to its bearings parallel to the extruding direction. On the other hand, it was also found that pick-up occurred easily on the surface of extrusion when the step mandrel was used. Dies were coated with diamond like carbon (DLC) around their bearings to prevent the dies from sticking of aluminum, and it was confirmed that the DLC coating has a significant effect to improve the condition of the surface of extruded pipes.
Author
Aluminum; Coating; Diamonds; Extruding; Pipes (Tubes); Shapes; Dies

20030068570 Technological Inst. for Superhard and Novel Carbon Materials, Troitsk, Russia
Formation of C-N Nanofibers in High Isostatic Pressure Apparatus and Their Field Emission Properties
Blank, V. D.; Batov, D. V.; Buga, S. G.; Kulnitskiy, B. A.; Polyakov, E. V.; Nahm, Sahn; Lee, Yun-Hi; Bangert, U.; Gutierrez-Sosa, A.; Harvey, A. J., et al.; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 533-538; In English; See also 20030068525; Original contains black and white illustrations
Contract(s)/Grant(s): INTAS-00-237; No Copyright; Avail: CASI; A02, Hardcopy

Carbon-nitrogen (CN) nanofibers have been formed in High Isostatic Pressure (HIP) apparatus in 1:1 nitrogen-argon gas mixture at 75 GPa using graphite electrical heater. Bamboo-like, beads-like, corrugated and spring-like nanofibers with the diameter of about 100-150 nm and the length over 10 microns have been found in a deposit with a low content of amorphous

carbon. The nitrogen content up to 8.5% was found in fibers by EELS analysis. The CN nanofibers were printed on cathode plate and the diode-type flat vacuum lamp with 1 inch diagonal was assembled for the field emission study with the gap between anode and cathode varying in the range of 300-900 microns. The turn-on fields were about 1.3 V/micron, the current density was 0.05 mA/sq cm at 1.35 V/micron. The time reliability and light emission test were carried out for above 100 hours. We suggest that CN nanofibers can be applied to the high brightness flat lamp because of low turn-on field and time reliability. Author

Nanofabrication; Carbon Nanotubes; High Pressure; Isostatic Pressure

20030068605 Chongqing Univ., China

Study on Gas Sensitivity of Carbon Nanotube Films

Wang, W. L.; Ma, Y.; Liao, K. J.; Wu. Z. H.; Liu, G. B.; Wan, B. Y.; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 101-105; In English; See also 20030068525; Original contains black and white illustrations; No Copyright; Avail: CASI; A01, Hardcopy

The gas sensitivity properties of carbon nanotubes were investigated. The carbon nanotubes in this study were fabricated by hot filament chemical vapor deposition using Ni/Fe catalyst. The sensor samples were treated by chemical etching using H2SO4/HNO3. The experimental results have shown that the electrical resistance of carbon nanotubes was sensitively changed on exposure to gaseous ambient containing ethanol and water vapor. It was found that the gas sensitivity of carbon nanotubes was greatly enhanced after chemical treatment. It was also shown that the response time of nanotube sensor was faster than that of usual sensors.

Author

Sensitivity; Carbon Nanotubes; Electrical Resistance; Nanostructures (Devices)

20030068646 Technische Univ., Berlin, Germany

Tribological Behavior of CVD Diamond Tools

Uhlmann, E.; Bruecher, M.; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 191-196; In English; See also 20030068525; Original contains black and white illustrations; No Copyright; Avail: CASI; A02, Hardcopy

Diamond cutting tools are often the only choice for the machining of high-strength and highly abrasive nonferrous alloys. During machining, a complex interaction of different wear mechanisms takes place on the tools. This interaction considerably hinders a purposeful detection of specific wear mechanisms. Therefore, the objective is to systematically analyze the wear processes that occur when machining a hypereutectic aluminum silicon alloy with CVD-diamond tools. The main wear mechanisms are identified and the limits for the use of various CVD-diamond tools are indicated. The findings gained will serve in the further development of these high-performance cutting materials.

Author

Tribology; Cutting; Diamonds; Aluminum Alloys; Silicon Alloys; Machine Tools

20030068665 NASA Glenn Research Center, Cleveland, OH, USA

Carbon-Based Wear Coatings: Properties and Applications

Miyoshi, Kazuhisa; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 404-405; In English; See also 20030068525; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

The technical function of numerous engineering systems - such as vehicles, machines, and instruments - depends on the processes of motion and on the surface systems. Many processes in nature and technology depend on the motion and dynamic behavior of solids, liquids, and gases. Smart surface systems are essential because of the recent technological push toward higher speeds, loads, and operating temperatures; longer life; lighter weight and smaller size (including nanotechnology); and harsh environments in mechanical, mechatronic, and biomechanical systems. If proper attention is not given to surface systems, then vehicles, machines, instruments, and other technical systems could have short lives, consume excessive energy, experience breakdowns, result in liabilities, and fail to accomplish their missions. Surface systems strongly affect our national economy and our lifestyles. At the NASA Glenn Research Center, we believe that proper attention to surface systems, especially in education, research, and application, could lead to economic savings of between 1.3 and 1.6 percent of the gross domestic product. Wear coatings and surface systems continue to experience rapid growth as new coating and surface engineering technologies are discovered, more cost-effective coating and surface engineering solutions are developed, and marketers aggressively pursue, uncover, and exploit new applications for engineered surface systems in cutting tools and wear

components. Wear coatings and smart surface systems have been used widely in industrial, consumer, automotive, aerospace, and biomedical applications. This presentation expresses the author's views of and insights into smart surface systems in wear coatings. A revolution is taking place in carbon science and technology. Diamond, an allotrope of carbon, joins graphite, fullerenes, and nanotubes as its major pure carbon structures. It has a unique combination of extreme properties: hardness and abrasion resistance; adhesion and friction; thermal conductivity; chemical and thermal inertness; corrosion and wear resistance; radiation resistance and biocompatibility; electronic, acoustic, and electrochemical characteristics; and environmental compatibility. These properties make diamond attractive for a wide range of diverse applications. In particular, chemical-vapor-deposited (CVD) diamond coatings offer a broad potential, since size and cost are not as limiting. The production of large, superhard diamond films or sheets at low cost make designer materials possible. This presentation is divided into two sections: properties and applications of hard coatings. The first section is concerned with the fundamental properties of the surfaces of CVD diamonds and related materials. The surface properties of hard coatings with favorable coefficients of friction (less than or equal to 0.1) and dimensional wear coefficients (less than or equal to 10(exp -6) cubic millimeters/N.m) in specific environments are discussed. The second section is devoted to applications. Examples of actual, successful applications and of potential challenging applications of the coatings.such as CVD diamond, diamondlike carbon, and cubic boron nitride-are described. Cutting tools coated with CVD diamond are of immediate commercial interest. Other applications, such as microelectromechanical systems (MEMS), valves, and bearings of CVD diamond, are being developed, but at a slow pace. There is a continually growing interest in commercializing diamondlike carbon for wear parts applications, such as biomedical parts and implants, forming dies, transport guides, magnetic tapes and disks, valves, and gears. Cubic boron nitride films are receiving attention because they can be used on tools to machine ferrous materials or on wear parts in sliding contact with ferrous materials.

Author

Carbon; Coatings; Wear; Surface Properties; Tribology; Diamond Films; Smart Materials

20030068680 Agency of Industrial Science and Technology, Tsukuba, Japan

The Tribological Properties of DLC Films Deposited by Hot Filament Plasma CVD Technique

Suzuki, Masahiro; Watanabe, Toshiya; Tanaka, Akihiro; Koga, Yoshinori; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003; 6 pp.; In English; See also 20030068525; Original contains black and white illustrations; No Copyright; Avail: CASI; A02, Hardcopy

Diamond-like carbon (DLC) films have good tribological properties such as a low friction coefficient and high wear resistance. However, the tribological properties of DLC films are significantly affected by other factors, such as the deposition technique, deposition conditions, and sliding conditions (velocity, normal load, and atmosphere). In this work, DLC films were deposited by a hot filament plasma Chemical Vapor Deposition (CVD) technique onto silicon wafers using a variety of source gases. The tribological properties of DLC films were investigated using a reciprocating friction tester under different sliding conditions in dry air, and the effects of test conditions, mating materials and source gases on the tribological properties of the DLC films were investigated. The tribological properties of DLC films were relatively unaffected by velocity and normal load, while mating materials had a considerable effect. The transfer layers formed on the mating material surfaces seems to play a significant role on the resulting tribological properties.

Author

Carbon; Tribology; Vapor Deposition; Filaments; Diamond Films; High Temperature Plasmas

20030068682 Nippon Inst. of Tech., Japan

Visco-Elastic Properties of Reactor on Diamond-Like Carbon Films in Boundary Lubrication

Saitoh, Tadashi; Miyake, S.; Watanabe, S.; Yasuda, Y.; Okamoto, Y.; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 440-443; In English; See also 20030068525

Contract(s)/Grant(s): MOE-B12450069; No Copyright; Avail: CASI; A01, Hardcopy

To improve the lubrication properties of DLC (Diamond-like Carbon) films, DLC films were deposited by adding additive materials such as titanium (Ti), iron (Fe), molybdenum (Mo) and titanium dioxide (TiO2) with using by magnetron sputtering, and its friction properties were evaluated by oscillation type scratch tester, and ball-on-disk type tribometer in oil lubricant. In the scratch test, it is found that the critical loads of ferrous and titanium containing DLC films were larger than DLC film without metal. Friction coefficient of DLC film without metal is nearly 0.10 when using oil lubrication containing MoDTC (molybdenum dithocarbamates). On the other hand, all materials containing DLC films show lower friction than DLC film without metal does. Especially, DLC film deposited with adding appropriate quantity of titanium exhibits a low friction coefficient mu = 0.03. In order to know mechanism of lower friction of titanium contained DLC film, the viscoelastic

properties of sliding and no-sliding areas were evaluated by force modulation method of AFM (Atomic Force Microscopy). The viscoelastic properties of sliding areas increased as comparing with that of no-sliding areas. It is thought that reactor of lower friction have been formed in sliding track of titanium containing DLC films in oil lubrication containing MoDTC.
Author
Carbon; Diamond Films; Lubrication; Viscoelasticity; Reactors

39
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 structures. For applications see *05 Aircraft Design, Testing and Performance*; and *18 Spacecraft Design, Testing and Performance*.

20030067907 National Advisory Committee for Aeronautics. Langley Aeronautical Lab., Langley Field, VA, USA
Rotating Disks in the Region of Permanent Deformation
Laszlo, F.; Zeitschrift fuer Angewandte Mathematik und Mechanik, Ingenieurwissenschaftliche Forschungsarbeiten; August 1948; Volume 5, No. 4, pp. 281-293; In English
Report No.(s): NACA-TM-1192; No Copyright; Avail: CASI; A03, Hardcopy

This technical memorandum is a mathematical investigation of the problem of overspeeded disks. New methods must be sought for obtaining a satisfactory stress equalization in the cross section of these disks.
CASI
Rotating Disks; Deformation

20030067936 Army Research Lab., Hampton, VA, USA, NASA Langley Research Center, Hampton, VA, USA
An Approximate Dissipation Function for Large Strain Rubber Thermo-Mechanical Analyses
Johnson, Arthur R.; Chen, Tzi-Kang; July 2003; 35 pp.; In English
Contract(s)/Grant(s): RTOP 755-06-00-13
Report No.(s): NASA/TM-2003-212430; NAS 1.15:212430; L-18308; ARL-TR-2998; No Copyright; Avail: CASI; A03, Hardcopy

Mechanically induced viscoelastic dissipation is difficult to compute. When the constitutive model is defined by history integrals, the formula for dissipation is a double convolution integral. Since double convolution integrals are difficult to approximate, coupled thermo-mechanical analyses of highly viscous rubber-like materials cannot be made with most commercial finite element software. In this study, we present a method to approximate the dissipation for history integral constitutive models that represent Maxwell-like materials without approximating the double convolution integral. The method requires that the total stress can be separated into elastic and viscous components, and that the relaxation form of the constitutive law is defined with a Prony series. Numerical data is provided to demonstrate the limitations of this approximate method for determining dissipation. Rubber cylinders with imbedded steel disks and with an imbedded steel ball are dynamically loaded, and the nonuniform heating within the cylinders is computed.
Author
Mathematical Models; Viscoelasticity; Thermodynamics; Dissipation; Rubber; Strain Distribution; Numerical Analysis

20030067962 NASA Glenn Research Center, Cleveland, OH, USA
Sensor Based Engine Life Calculation: A Probabilistic Perspective
Guo, Ten-Huei; Chen, Philip; August 2003; 13 pp.; In English; 16th International Symposium on Airbreathing Engines, 31 Aug. - 5 Sep. 2003, Cleveland, OH, USA
Contract(s)/Grant(s): WBS 22-704-30-01
Report No.(s): NASA/TM-2003-212499; E-14059; NAS 1.15:212499; ISABE-2003-1147; No Copyright; Avail: CASI; A03, Hardcopy

It is generally known that an engine component will accumulate damage (life usage) during its lifetime of use in a harsh operating environment. The commonly used cycle count for engine component usage monitoring has an inherent range of uncertainty which can be overly costly or potentially less safe from an operational standpoint. With the advance of computer technology, engine operation modeling, and the understanding of damage accumulation physics, it is possible (and desirable) to use the available sensor information to make a more accurate assessment of engine component usage. This paper describes a probabilistic approach to quantify the effects of engine operating parameter uncertainties on the thermomechanical fatigue

(TMF) life of a selected engine part. A closed-loop engine simulation with a TMF life model is used to calculate the life consumption of different mission cycles. A Monte Carlo simulation approach is used to generate the statistical life usage profile for different operating assumptions. The probabilities of failure of different operating conditions are compared to illustrate the importance of the engine component life calculation using sensor information. The results of this study clearly show that a sensor-based life cycle calculation can greatly reduce the risk of component failure as well as extend on-wing component life by avoiding unnecessary maintenance actions.
Author
Engine Parts; Fatigue Life; Life (Durability); Statistical Analysis; Component Reliability

20030067979 Naval Postgraduate School, Monterey, CA
The Military Housing Privatization Initiative and the Defense Department's Military Family Housing Revitalization Plan
Beard, Kirby D.; Mar. 2003; 145 pp.; In English
Report No.(s): AD-A414850; No Copyright; Avail: CASI; A07, Hardcopy

Throughout our nation's history, the armed forces struggled to provide an adequate quantity and quality of living quarters for service members and their families because competing budget priorities continually overshadowed the need for more and better housing. The trend worsened during the 1990's, with traditional on base housing stocks deteriorating due to insufficient maintenance funding, inadequate new construction funding, and meager housing allowance increases. Supporting the continued and growing emphasis on the welfare of service families, Congress authorized the Military Housing Privatization Initiative (MHPI) in 1996 to take advantage of outsourcing opportunities and to quickly alleviate the housing problem. This thesis compares MHPI to the other two traditional family housing programs (MILCON and BAH) and analyzes many specific MHPI strengths and weakness. The research concludes that MHPI is a valuable and flexible tool for bridging the perpetual gap between the MILCON program (limited by congressional appropriations) and the housing allowance program (limited by local real estate markets). Since many long-term uncertainties exist regarding DoD's future housing needs and the resulting effect of the BAH rate increase initiative, this thesis recommends that MHPI be used only when MILCON and BAH can not meet housing needs. Additionally, it recommends that DoD not count on projected MHPI cost savings, which are unlikely to materialize; and that DoD use MHPI projects as an opportunity to increase utility conservation responsibilities for service families.
DTIC
Armed Forces; Construction; Deterioration

20030068121 NASA Langley Research Center, Hampton, VA, USA
A Variational Principle for Reconstruction of Elastic Deformations in Shear Deformable Plates and Shells
Tessler, Alexander; Spangler, Jan L.; August 2003; 20 pp.; In English
Contract(s)/Grant(s): RTOP 755-06-00
Report No.(s): NASA/TM-2003-212445; L-19000; NAS 1.15:212445; No Copyright; Avail: CASI; A03, Hardcopy

A variational principle is formulated for the inverse problem of full-field reconstruction of three-dimensional plate/shell deformations from experimentally measured surface strains. The formulation is based upon the minimization of a least squares functional that uses the complete set of strain measures consistent with linear, first-order shear-deformation theory. The formulation, which accommodates for transverse shear deformation, is applicable for the analysis of thin and moderately thick plate and shell structures. The main benefit of the variational principle is that it is well suited for C(sup 0)-continuous displacement finite element discretizations, thus enabling the development of robust algorithms for application to complex civil and aeronautical structures. The methodology is especially aimed at the next generation of aerospace vehicles for use in real-time structural health monitoring systems.
Author
Elastic Deformation; Variational Principles; Shells (Structural Forms); Reconstruction; Three Dimensional Models; Plates (Structural Members); Shear Stress

20030068185 Louisiana Tech Univ., Ruston, LA, USA
Preliminary Thermal Stress Analysis of a High-Pressure Cryogenic Storage Tank
Baker, J. Mark; July 02, 2003; 8 pp.; In English
Report No.(s): SE-2003-06-0043-SSC; No Copyright; Avail: CASI; A02, Hardcopy

The thermal stresses on a cryogenic storage tank strongly affect the condition of the tank and its ability to withstand

operational stresses. These thermal stresses also affect the growth of any surface damage that might occur in the tank walls. These stresses are particularly of concern during the initial cooldown period for a new tank placed into service, and during any subsequent thermal cycles. A preliminary thermal stress analysis of a high-pressure cryogenic storage tank was performed. Stresses during normal operation were determined, as well as the transient temperature distribution. An elastic analysis was used to determine the thermal stresses in the inner wall based on the temperature data. The results of this elastic analysis indicate that the inner wall of the storage tank will experience thermal stresses of approximately 145,000 psi (1000 MPa). This stress level is well above the room-temperature yield strength of 304L stainless steel, which is about 25,000 psi (170 MPa). For this preliminary analysis, several important factors have not yet been considered. These factors include increased strength of 304L stainless steel at cryogenic temperatures, plastic material behavior, and increased strength due to strain hardening. In order to more accurately determine the thermal stresses and their affect on the tank material, further investigation is required, particularly in the area of material properties and their relationship to stress.
Author
Cryogenic Temperature; High Pressure; Storage Tanks; Stress Analysis; Thermal Stresses

20030068418 Cornell Univ., Ithaca, NY, USA
Elastic Properties of Films of Water and Noble Gases Condensed at Low Temperatures
Pohl, Robert O.; Aug. 31, 2003; 4 pp.; In English
Contract(s)/Grant(s): NAG5-7508; No Copyright; Avail: CASI; A01, Hardcopy

We have shown that there are extensive similarities between the quench-condensed noble gas films and those of amorphous water ice. In particular, both can be quite soft upon deposition and can stiffen considerably when annealed. Furthermore, this stiffening follows a logarithmic time dependence for all substances. The temperature dependence of these behaviors scales with the triple point. The results shown here show a strong thickness dependence, which has implications for any study of mechanical properties of films on substrates. The temperature dependence of the stiffening and the stiffening rate have now been characterized for the noble gases, and these observations provide a roadmap for new experiments on amorphous water ice.
Author
Elastic Properties; Low Temperature; Rare Gases; Water; Interplanetary Medium; Mechanical Properties; Film Thickness

20030068596 Surrey Univ., Guildford, UK
Structural Analysis of Carbon Nanofibres Synthesised at Room Temperature
Boskovic, B. O.; Stolojan, V.; Zeze, D. A.; Forrest, R. D.; Silva, S. R. P.; Haq, S.; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 59-63; In English; See also 20030068525; Original contains black and white illustrations; No Copyright; Avail: CASI; A01, Hardcopy

Structural characteristics of carbon nanofibres synthesised using radio frequency plasma enhanced chemical vapour deposition (PECVD) and radio frequency assisted microwave PECVD at room temperature were determined using transmission electron microscopy and Raman analysis. The material was generated by the catalytic growth of carbon nanofibres at room temperature using an industry standard radio frequency (13.56 MHz) PECVD and custom designed microwave combined radio frequency PECVD. The thermal energy requirements for the growth were substituted by plasma decomposition of methane upon a nickel catalyst. Room temperature synthesis conditions offer the advantage of growing carbon nanofibres and nanotubes on different temperature sensitive substrates, such as organic materials, plastics and other polymers over relatively large areas. Carbon nanofibres grown using radio frequency combined microwave PECVD exhibit branching during the growth thus forming 'Y'-shaped junctions. The interconnecting networks formed by the branched carbon nanofibres could be useful for nanoelectronics applications. The characteristic D and G peaks were observed in the Raman spectra and their intensity ratio and peak width were compared. Electron microscopy analysis provides evidence for a 'tip' growth model, with the nickel catalyst particle attached to the tip of the nanofibre.
Author
Structural Analysis; Carbon Nanotubes; Vapor Deposition; Synthesis (Chemistry)

20030068660 Parana Federal Univ., Curitiba, Brazil
Mechanical Properties of ta-C Films Deposited on Polyethylene and Metallic Substrates
Siqueira, Carlos J. M.; Veiga, Wanderley; Poliakov, Vladimir P.; Huemmelgen, Ivo A.; Kirpilenko, Gregory G.; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 471; In English; See also 20030068525; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

Research in the area of advanced materials application in artificial prosthetics with a view to minimize the biochemical and mechanical complications of implanted materials is carried out. In this paper the results of physical chemical characterization, mechanical properties (nano-hardness, elastic modulus) and tribological testes of ta-C films deposited on ultra high molecular weight polyethylene (UHMWPE) and metallic substrates (Ti, Co-Cr- Mo, stainless steel 138F, hard alloy) are presented. These films were obtained by pulsed arc plasma method (physical vapour deposition, PVD) using a carbon source accelerator in a vacuum of 2 x 10(exp -4) Pa. Physical chemical characterization of ta-C films had been carried out by different methods. The nano-hardness and elastic modulus of ta-C films (approximately 250 nanometers) deposited on the metallic and UHMWPE substrates were measured by nanoindentation method. It was determined that the nano-hardness and elastic modulus are larger for ta-C deposited on the metallic substrates than that deposited on UHMWPE. Wear resistance and the coefficient of friction of ta-C film were measured by different methods.
Author
Mechanical Properties; Polyethylenes; Tribology; Substrates; Metals; Titanium; Carbon; Nanotechnology; Deposition

20030068919 NASA Marshall Space Flight Center, Huntsville, AL, USA
Determination of Significant Composite Processing Factors by Designed Experiment (MSFC Center Director's Discretionary Fund)
Finckenor, J. L.; July 2003; 82 pp.; In English
Contract(s)/Grant(s): Proj. 95-23
Report No.(s): NASA/TM-2003-212633; M-1080; NAS 1.15:212633; No Copyright; Avail: CASI; A05, Hardcopy

To determie composite material properties' effects from porcessing variables, a 3 factorial designed experiment with two replicates was conducted. The factors were cure method (oven versus autoclave), layup (hand versus tape-laying machine), and thickness (8 versus 52 ply). Four material systems were tested: AS4/3501-6, IM7/8551-7, IM7/F655 bismaleimide (BMI), and shear tests on IM7/F584. Material properties were G(sub 12), v(sub 12), E(sub 1c) and E(sub 2c). Since the samples were necessarily nonstandard, strengths, though recorded, cannot be considered valid. Void content was also compared. Autoclave curing helped material properties for the low modulus fiber material but showed little benefit for higher stiffness fibers. The number of plies was very important for epoxy composites but not for the BMI. E(sub 1) was generally unaffected by any factor. Particularly high void content did correlate to reduced properties. Autoclave curing reduced void content over oven curiing but a moderate amount of voids, less than 1 percent void content, didnot correlate with material properties. Oven cures and hand layups can produce high-quality parts. Part thickness of epoxy composites is important, though cure optimization may improve performance. Significant variations can be caused by processing and it is important that test coupons always reflect the layup and processes of the final part.
Author
Composite Materials; Mechanical Properties; Manufacturing; Experiment Design; Factorials

42
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 42 through 48*.

20030067919 California Univ., San Diego, La Jolla, CA, USA
Prebiotic Synthesis of Adenine and Amino Acids Under Europa-like Conditions
Levy, Matthew; Miller, Stanley L.; Brinton, Karen; Bada, Jeffrey L.; Icarus; January 2003; ISSN 0019-1035; Volume 146, pp. 609-613; In English; Original contains black and white illustrations
Contract(s)/Grant(s): NAG5-4546; Copyright; Avail: Other Sources

In order to simulate prebiotic synthetic processes on Europa and other ice-covered planets and satellites. we have investigated the prebiotic synthesis of organic compounds from dilute solutions of NH4CN frozen for 25 year at -20 and -78 C. In addition the aqueous products of spark discharge reactions from a reducing atmosphere were frozen for 5 years at -20%. We find that both adenine and guanine, as well as a simple set of amino acids dominated by glycine, are produced in substantial yields under these conditions. These results indicate that some of the key components necessary for the origin of life may have been available on Europa throughout its history and suggest that the circumstellar zone where life might arise may be m der than previously thought.
Author
Synthesis (Chemistry); Organic Compounds; Dilution; Biological Evolution; Amino Acids

20030067933 Nevada Univ., Reno, NV, USA
Global Assessment of Volcanic Debris Hazards from Space
Watters, Robert J.; [2003]; 7 pp.; In English
Contract(s)/Grant(s): NAG5-9498; No Copyright; Avail: CASI; A02, Hardcopy

Hazard (slope stability) assessment for different sectors of volcano edifices was successfully obtained from volcanoes in North and South America. The assessment entailed Hyperion images to locate portions of the volcano that were hydrothermally altered to clay rich rocks with zones that were also rich in alunite and other minerals. The identified altered rock zones were field checked and sampled. The rock strength of these zones was calculated from the field and laboratory measurements. Volcano modeling utilizing the distinct element method and limit equilibrium technique, with the calculated strength data was used to assess stability and deformation of the edifice. Modeling results give indications of possible failure volumes, velocities and direction. The models show the crucial role hydrothermally weak rock plays in reducing the strength o the volcano edifice and the rapid identification of weak rock through remote sensing techniques. Volcanoes were assessed in the Cascade Range (USA), Mexico, and Chile (ongoing).
Derived from text
Volcanoes; Space Debris; Deformation; Hazards

20030068111
The Influence of a Forest Canopy on Top-down and Bottom-up Diffusion in the Planetary Boundary Layer
Patton, E. G.; Sullivan, P. P.; Davis, K. J.; Royal Meteorological Society; 2003, pp. 1415-1434; In English
Contract(s)/Grant(s): NAG5-8839; EPA/R825379; Copyright; Avail: Other Sources

Results from two nested-grid large-eddy simulations comparing cases with and without a plant canopy are presented. Through comparisons of numerically generated mean and turbulence statistics, the influence of a plant canopy with a leaf area index of two is shown to modify the air flow compared with an identical case without plants. Investigations of instantaneous fields and spatial spectra show that a plant canopy alters the spatial structure of turbulence and acts to shift the dominant scale to a scale on the order of the canopy height. Distributed drag and scalar sources, representing the presence of a scalar emitting deciduous forest, have little influence on topdown diffusion, but enhanced mixing and increased turbulence intensities result in a dramatic modification to bottom-up scalar diffusion up to approximately 4.5 times the height of the canopy. Use of previously proposed bottom-up gradient function with observations of scalar gradients under unstable stability conditions at 50 m over a 25 m tall forest (leaf area index of two) are shown to lead to an underestimate of the scalar emission flux by a factor of four. New topdown and bottom-up functions are proposed to include these canopy-induced effects for this particular canopy.
Author
Canopies (Vegetation); Diffusion; Forests; Planetary Boundary Layer; Numerical Analysis

20030068341 Scripps Institution of Oceanography, La Jolla, CA, USA
Reassessing the Evidence for the Earliest Traces of Life
vanZullen, Mark A.; Lepland, Alve; Arrhenlus, Gustaf; Letters to Nature; August 8, 2002; Volume 418, pp. 627-630; In English
Contract(s)/Grant(s): NAG5-4546; Copyright; Avail: Other Sources

The isotopic composition of graphite is commonly used as a biomarker in the oldest (>3.5 Gyr ago) highly metamorphosed terrestrial rocks. Earlier studies on isotopic characteristics of graphite occurring in rocks of the approximately 3.8-Gyr-old Isua supracrustal belt (ISB) in southern West Greenland have suggested the presence of a vast microbial ecosystem in the early Archean. This interpretation, however, has to be approached with extreme care. Here we show that graphite occurs abundantly in secondary carbonate veins in the ISB that are formed at depth in the crust by injection of hot fluids reacting with older crustal rocks (metasomatism). During these reactions, graphite forms from the disproportionation of Fe(II)-bearing carbonates at high temperature. These metasomatic rocks, which clearly lack biological relevance, were earlier thought to be of sedimentary origin and their graphite association provided the basis for inferences about early life. The new observations thus call for a reassessment of previously presented evidence for ancient traces of life in the highly metamorphosed Early Archaean rock record.
Author
Biomarkers; Precambrian Period; Graphite; Isotope Ratios

43
EARTH RESOURCES AND REMOTE SENSING

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

20030067806
Training Device Software Enhancement
Dow, Stephen J.; May 14, 2003; 6 pp.; In English
Contract(s)/Grant(s): DAAH01-97-D-R005
Report No.(s): AD-A414784; 5-21859; No Copyright; Avail: CASI; A02, Hardcopy

The set of SED Basic Skills Trainers display 3D target models on a background panoramic terrain image created from photographs. This report documents the mathematical methods and operational details used to stitch individual photographs into a composite terrain image.

DTIC
Software Engineering; Training Devices

20030068013 National Information Display Lab., Princeton, NJ, USA
Evaluation of the Samsung 240T Analog and Digital, 24-Inch Diagonal 1920 x 1200 Pixel LCD Color Monitor
Dec. 31, 2001; 82 pp.; In English; Original contains color illustrations
Report No.(s): AD-A415149; NIDL-750810701-123; No Copyright; Avail: CASI; A05, Hardcopy

The Samsung 240T, 24 inch, 1920 x 1200 pixel LCD color monitor ($5511) is the first LCD that has the capability for both digital and analog addressing at the full 1920 x 1200 addressability. NIDL reports here results on extensive digital and analog testing. We found that digital addressing improves the sharpness of visually observed SMPTE test patterns, of measured profiles of a single pixel wide line, and of Briggs patterns. This improvement is achieved in part by eliminating a spurious extra part of a pixel (phantom) observed in analog mode. We achieved 1920 x 1200 digital addressing by using an Elsa Synergy III graphics card in the single head mode with a single DVI channel by decreasing the vertical refresh rate to 52 Hz. Images look excellent with no flicker at this lower refresh rate. At 1920 x 1200 digital addressability, Briggs scores are 16, 38, 59 and 71 for the Delta-i, Delta-3, Delta-7 and Delta-15 contrast ratio targets, compared to 12, 34, 55 and 58 in the analog mode. The constancy of illumination in an LCD display allows the vertical refresh rate to be reduced to 52 Hz without observable flicker; the geometrical arrangement of the backlight, however, can lead to a somewhat higher luminance non-uniformity (23.4% versus 20% WC requirement for CRT monitors). Luminance rise time in digital mode averages 13 ms compared to 20 ms in analog mode. The Samsung 240T LCD easily surpassed the WC specifications for luminance, contrast ratio, halation, CCT, reflectance, tonal transfer curve, uniformity of chromaticity, pixel aspect ratio, contrast modulation, jitter/swim/drift, and warm-up time. NIDL rates the 240T a 'B' in a monoscopic mode and therefore certifies it as an acceptable color monitor in a dual head WC workstation. Also, it could be used as the main task monitor for a non-stereo mode color workstation, as is utilized at NAVO WSC. It cannot replace a CRT where a stereoscopic-mode capable color monitor is required.

DTIC
Optical Properties; Monitors; Evaluation; Color; Observation; Reflectance

20030068024 National Information Display Lab., Princeton, NJ, USA
Quick Look at the ViewSonic P815-4M (Lockheed Martin 2001) 4 x 3 Aspect Ratio, 21-Inch Diagonal Color CRT Monitor for Stereo
Oct. 17, 2001; 25 pp.; In English; Original contains color illustrations
Report No.(s): AD-A415157; NIDL-750810901-127; No Copyright; Avail: CASI; A03, Hardcopy

NIDL does not certify the ViewSonic P8 1 5-4M color monitor as being suitable for IEC workstations requiring a stereo-capable 1024 x 1024 pixel addressability color monitor. We rate the monitor 'C' because it can achieve only 110 Hz vertical refresh rate at 1024 x 1024 pixel addressability, rather than the IEC Working Group specified 120 Hz. Monitors passing the lEC stereo 120 Hz specification are listed.

DTIC
Optical Properties; Monitors; Stereoscopic Vision

20030068054 Air Force Inst. of Tech., Wright-Patterson AFB, OH, USA

An Economic Evaluation of Binary Cycle Geothermal Electricity Production

Fitzgerald, Crissie D.; Mar. 2003; 80 pp.; In English; Original contains color illustrations

Report No.(s): AD-A415022; AFIT/GEE/ENV/03-07; No Copyright; Avail: CASI; A05, Hardcopy

The U.S. is heavily dependent on fossil fuels to produce electricity. Geothermal energy, the heat in the earth's crust, can provide an alternative source of energy for electricity production as well as reduce fossil fuel consumption. The economic analysis presented in this study focuses on binary cycle geothermal electricity production. Variables such as well flow rate, geothermal gradient and electricity prices were varied to study their influence on the economic payback period for binary cycle geothermal electricity production. Payback periods represent the amount of time (in years) necessary to recover initial costs of plant construction.

DTIC

Economic Analysis; Electricity; Fuel Production; Geothermal Energy Conversion

20030068072 National Information Display Lab., Princeton, NJ, USA

Evaluation of the SIEMENS SMM 21105 L (STEREO) 4 x 3 Aspect Ratio, 21-Inch Diagonal High Contrast Gray Scale CRT Monitor Manufactured July 2001

Sep. 11, 2001; 78 pp.; In English; Original contains color illustrations

Report No.(s): AD-A415147; NIDL-750810801-125; No Copyright; Avail: CASI; A05, Hardcopy

Siemens developed the 21105 monitor as an improved version of the 21103. The 21105 uses a high resolution 5-megapixel electron gun to achieve a finer spot size at 35 IL in the monoscopic mode. Concomitantly, the CRT faceplate transmission was increased from 28% to 42%.

DTIC

Optical Properties; Monitors

20030068073 National Information Display Lab., Princeton, NJ, USA

Evaluation of the Sony GDM-FW900 16:10 Aspect Ratio, 24-Inch Diagonal Flat Face CRT Color Monitor

Sep. 6, 2001; 58 pp.; In English; Original contains color illustrations

Report No.(s): AD-A415156; NIDL-751810601-120; No Copyright; Avail: CASI; A04, Hardcopy

The Sony GDM-FW900 24 inch, flat face monitor (22. 5' viewable area; selling price $1999.99) is new both in its flat face CRT and in its improved electronics. It is a color monitor with excellent image quality and features that make it an excellent display device for NIMA Imagery Exploitation Capability workstations. The Sony GDM-FW900 is a distinct improvement, except for halation and linearity, over the previous model Sony GDM-W900/Sun Microsystems 365- 1352-01 color monitor that NIDL had certified for WC workstation monoscopic-mode color operation. NIDL rates this color monitor 'A' in monoscopic mode and thereby certifies the 24 inch Sony GDM-FW900 color monitor as being suitable for WC workstations in the monoscopic-mode. NIDL tested the monitor at an addressability of 1920 x 1200 pixels, as would be used in an T IEC W2K PC-based workstation. Our tests show that the monoscopic contrast modulation is excellent and exceeds 48% in Zone A and 38% over the face of the whole CkT, well above the tEC minimum perfbrmance values. The reliability of the Sony GDM-FW900 monitor is expected to be excellent; it has a limited WALTanty of 3 years for parts, labor and the CRT. NIOL has used the previous Sony GDM-W900 version of this monitor for several years now without any failures and with continued excellent perlormance. The 16:10 wide aspect ratio and the 24 inch diagonal give the analyst a larger working area than a 21 inch monitor does. The 24' Flat Trinitron CkT wide screen monitor will display up to 2304 x 1440 pixels at 80 Hz. The CRT has a 0.23mm aperture grille pitch at the center increasing to 0.27mm at the edges of the screen. The manutacturer recommended addressability setting is 1920 x 1200 at 85Hz.

DTIC

Optical Properties; Monitors

20030068089 National Information Display Lab., Princeton, NJ, USA

Evaluation of the Sony GDM-F520 21-Inch Diagonal Color CRT Monitor for Monoscopic and Stereoscopic Imagery

Dec. 21, 2001; 70 pp.; In English; Original contains color illustrations

Report No.(s): AD-A415161; NIDL-750811001-128; No Copyright; Avail: CASI; A04, Hardcopy

Color monitors are more difficult to evaluate and their performance may not compare to monochrome monitors. Color monitors have three electron guns (R, G, and B) to focus and converge. They also have a perforated steel shadow mask that separates the colors on the screen and this adds complexity. Color lines formed on the phosphor screen may not be as narrow

as for a monochrome, single electron gun-formed spot. The color monitor's light output may not be as high. The IEC monitor specifications for color monitors reflect this difference, and have lower luminance and stereo extinction ratio requirements than a monochrome monitor. In spite of these limitations, Imagery and Geospatial Analysts at a number of sites may do all their analyses on color monitors.
DTIC
Optical Properties; Monitors

20030068090 National Information Display Lab., Princeton, NJ, USA
Evaluation of the MegaScan MD2-4810 LS 11 x 11-Inch Addressable 21-Inch Diagonal Monochrome CRT Monitor
Aug. 31, 2001; 54 pp.; In English; Original contains color illustrations
Report No.(s): AD-A415158; NIDL-750810601-121; No Copyright; Avail: CASI; A04, Hardcopy

NIDL concludes that the MegaScan MD2-4810-LS grayscale monitor (serial number 9007) meets the requirements to serve as a lorm, fit, and function replacement for the Tektronix GMA-203 as it is presently used as a stereo display in a dark environment.
DTIC
Optical Properties; Monitors

20030068115 NASA Marshall Space Flight Center, Huntsville, AL, USA
Aerial and Ground-Based Remote Sensing In Central America
Sheets, Payson; Sever, Thomas L.; Conyers, Larry; [2003]; 1 pp.; In English; No Copyright; Avail: Other Sources; Abstract Only

Remote sensing of archaeological features is most successful when instrumentation and imagery are carefully selected bearing in mind the nature of the remains and the local context. Instruments need to be calibrated to local conditions, and extensive field verification studies are necessary. This is illustrated by remote sensing in two research programs in Central America: the Arena1 Research Program in Costa Rica and the Ceren Research Program in El Salvador. Satellite and aircraft remote sensing was successful in the former, while the Ceren site required the development of ground-based geophysical exploration techniques. In both cases, remote sensing contributed information that was not available by any other means, thus allowing new interpretations and a fuller understanding of ancient societies.
Author
Remote Sensing; Satellite Observation; Ground Truth; Calibrating

20030068158 Clemson Univ., SC
Environmental Management Science Program. Advanced Sensing and Control Techniques to Facilitate Semi-Autonomous Decommissioning
Schalkoff, R. J.; Geist, R. M.; Dawson, D. M.; Jun. 01, 1998; 7 pp.; In English
Report No.(s): DE2003-13498; No Copyright; Avail: Department of Energy Information Bridge

This research is intended to advance the technology of semi-autonomous teleoperated robotics as applied to Decontamination and Decommissioning (D&D) tasks. Specifically, research leading to a prototype dual-manipulator mobile work cell is underway. This cell is supported and enhanced by computer vision, virtual reality and advanced robotics technology. This report summarizes work after approximately 1.5 years of a 3-year project. The autonomous, non-contact creation of a virtual environment from an existing, real environment (virtualization) is an integral part of the workcell functionality. This requires that the virtual world be geometrically correct. To this end, we have encountered severe sensitivity in quadric estimation.
NTIS
Autonomy; Decommissioning; Environment Management; Control Theory; Remote Sensing

20030068265 Swedish Defence Research Establishment, Linkoeping
A Short Introduction to the Principal Components Transformation and the Canonical Discriminant Analysis of Multispectral Data
Hallberg, T.; Jan. 2002; In English
Report No.(s): PB2003-103162; FOI-R-0382-SE; No Copyright; Avail: National Technical Information Service (NTIS)

This report reviews shortly two different algorithms for multispectral data analysis: the principal components transform (PC transform) and the kanonical discriminant analysis (KD analysis). These algorithms are widely used in multispectral and

hyperspectral sensing for classification and identification of different objects, e.g. different types of crops, vegetation and minerals. Both the algorithms find a set of eigenvectors or filter functions which include the spectral features which are necessary for optimal classification but exclude redundant spectral data. While the PC transform treats the different spectral classes globally without concern to class structure in the data the KD analysis will maximize the ratio between the among-class variance and the within-class variance by which class separation is optimized.
NTIS
Algorithms; Emission Spectra; Remote Sensing; Discriminant Analysis (Statistics); Spectrum Analysis

20030068489 National Center for Atmospheric Research, Boulder, CO, USA
Influence of Idealized Heterogeneity on Wet and Dry Planetary Boundary Layers Coupled to the Land Surface, 2
Houser, Paul, Technical Monitor; Patton, Edward G.; Sullivan, Peter P.; Moeng, Chin-Hoh; [2003]; 57 pp.; In English
Report No.(s): NCAR-1998-290; No Copyright; Avail: CASI; A04, Hardcopy

We examine the influence of surface heterogeneity on boundary layers using a large-eddy simulation coupled to a land-surface model. Heterogeneity, imposed in strips varying from 2-30 km (1 less than lambda/z(sub i) less than 18), is found to dramatically alter the structure of the free convective boundary layer by inducing significant organized circulations. A conditional sampling technique, based on the scale of the surface heterogeneity (phase averaging), is used to identify and quantify the organized surface fluxes and motions in the atmospheric boundary layer. The impact of the organized motions on turbulent transport depends critically on the scale of the heterogeneity lambda, the boundary layer height zi and the initial moisture state of the boundary layer. Dynamical and scalar fields respond differently as the scale of the heterogeneity varies. Surface heterogeneity of scale 4 less than lamba/z(sub i) less than 9 induces the strongest organized flow fields (up, wp) while heterogeneity with smaller or larger lambda/z(sub i) induces little organized motion. However, the organized components of the scalar fields (virtual potential temperature and mixing ratio) grow continuously in magnitude and horizontal scale, as lambda/z(sub i) increases. For some cases, the organized motions can contribute nearly 100% of the total vertical moisture flux. Patch-induced fluxes are shown to dramatically impact point measurements that assume the time-average vertical velocity to be zero. The magnitude and sign of this impact depends on the location of the measurement within the region of heterogeneity.
Author
Heterogeneity; Planetary Boundary Layer; Earth Surface; Surface Layers; Moisture; Mathematical Models; Drying

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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*.

20030067719 Vanderbilt Univ., Nashville, TN, USA
Nanocomposites as Designed Catalysts for Direct Methanol Fuel Cells
Lukehart, Charles M.; Mar. 4, 2002; 9 pp.; In English
Contract(s)/Grant(s): DAAG55-98-1-0362
Report No.(s): AD-A414697; ARO-38717.26-CH; No Copyright; Avail: CASI; A02, Hardcopy

The specific aim of this research project is the development of novel methods for preparing improved catalysts for direct methanol fuel cells (DMFCs) These catalysts consist of metal alloy nanoclusters dispersed onto a conductive carbon support Synthetic control of the alloy nanocluster composition is achieved by preparing molecular precursors in which the precursor contains two or more metals of a desired stoichiometry Adsorption of single-source molecular precursors onto Vulcan carbon powder followed by appropriate thermal treatment affords metal alloy or intermetallic/carbon nanocomposites.
DTIC
Composite Materials; Catalysts; Methyl Alcohol

20030068063 NASA Glenn Research Center, Cleveland, OH, USA
Regenerative Fuel Cell Test Rig at Glenn Research Center
Chang, Bei-Jiann; Johnson, Donald W.; Garcia, Christopher P.; Jakupca, Ian J.; Scullin, Vincent J.; Bents, David J.; July 2003; 22 pp.; In English; First International Energy Conversion Engineering Conference, 17-21 Aug. 2003, Portsmouth, VA, USA
Contract(s)/Grant(s): WBS 22-710-10-02
Report No.(s): NASA/TM-2003-212375; E-13951; NAS 1.15:212375; AIAA Paper 2003-5942; No Copyright; Avail: CASI; A03, Hardcopy

The regenerative fuel cell development effort at Glenn Research Center (GRC) involves the integration of a dedicated fuel cell and electrolyzer into an energy storage system test rig. The test rig consists of a fuel cell stack, an electrolysis stack, cooling pumps, a water transfer pump, gas recirculation pumps, phase separators, storage tanks for oxygen (O2) and hydrogen (H2), heat exchangers, isolation valves, pressure regulators, interconnecting tubing, nitrogen purge provisions, and instrumentation for control and monitoring purposes. The regenerative fuel cell (RFC) thus formed is a completely closed system which is capable of autonomous cyclic operation. The test rig provides direct current (DC) load and DC power supply to simulate power consumption and solar power input. In addition, chillers are used as the heat sink to dissipate the waste heat from the electrochemical stack operation. Various vents and nitrogen (N2) sources are included in case inert purging is necessary to safe the RFC test rig.
Author
Electrolysis; Regenerative Fuel Cells

20030068184 Alaska Univ., Fairbanks, AK, USA
Oxygen Transport Ceramic Memebranes. Quarterly Report
Bandopadhyay, S.; Nagabhushana, N.; Jun. 2000; In English
Report No.(s): DE2003-807452; No Copyright; Avail: National Technical Information Service (NTIS)

Conversion of natural gas to liquid fuels and chemicals is a major goal for the Nation as it enters the 21st Century. Technically robust and economically viable processes are needed to capture the value of the vast reserves of natural gas on Alaska's North Slope, and wean the Nation from dependence on foreign petroleum sources. Technologies that are emerging to fulfill this need are all based syngas as an intermediate. Syngas (a mixture of hydrogen and carbon monoxide) is a fundamental building block from which chemicals and fuels can be derived. Lower cost syngas translates directly into more cost-competitive fuels and chemicals. The currently practiced commercial technology for making syngas is either steam methane reforming (SMR) or a two-step process involving cryogenic oxygen separation followed by natural gas partial oxidation (POX). These high-energy, capital-intensive processes do not always produce syngas at a cost that makes its derivatives competitive with current petroleum-based fuels and chemicals.
NTIS
Ceramics; Oxygen; Membrane Structures

20030068230 Alaska Univ., Fairbanks, AK, USA
Oxygen Transport Ceramic Membranes. Quarterly Report
Bandopadhyay, S.; Nagabhushana, N.; Jul. 2001; In English
Report No.(s): DE2003-807454; No Copyright; Avail: National Technical Information Service (NTIS)

Conversion of natural gas to liquid fuels and chemicals is a major goal for the Nation as it enters the 21st Century. Technically robust and economically viable processes are needed to capture the value of the vast reserves of natural gas on Alaska's North Slope, and wean the Nation from dependence on foreign petroleum sources. Technologies that are emerging to fulfill this need are all based syngas as an intermediate. Syngas (a mixture of hydrogen and carbon monoxide) is a fundamental building block from which chemicals and fuels can be derived. Lower cost syngas translates directly into more cost competitive fuels and chemicals.
NTIS
Ceramics; Membranes

20030068258 American Iron and Steel Inst., Pittsburgh, PA, USA
Development of an Oxygen-Enriched Furnace System for Reduced CO(Sub 2) and NO(Sub x) Emissions for the Steel Industry
Grandmaison, E. W.; Poirier, D. J.; Boyd, E.; Jan. 20, 2003; 140 pp.; In English
Report No.(s): DE2003-807640; No Copyright; Avail: Department of Energy Information Bridge

The purpose of this report was to develop an Oxygen-enriched furnace system that will reduce carbon dioxide and nitrous oxide emissions under typical steel industry operating conditions. The combination of the latest burner technology for air-fuel combustion with oxygen -enrichment should result in both lower nitrous oxide emissions and reduced carbon dioxide emissions. The issues that were addressed by this work include: (1) the optimum configuration of the ultra-low-nitrous oxides burner for high energy efficiency (low carbon dioxide), low nitrous oxide emissions and uniform heat flux distribution, (2) the

effect of air infiltration on furnace performance during oxygen-enriched combustion, and (3) the effect of oxygen-enrichment combustion on scale formation in steel reheat furnaces.
NTIS
Air Pollution; Pollution Control; Emission; Steels; Furnaces

20030068268 NASA Glenn Research Center, Cleveland, OH, USA
On-Orbit Performance Degradation of the International Space Station P6 Photovoltaic Arrays
Kerslake, Thomas W.; Gustafson, Eric D.; July 2003; 11 pp.; In English; First International Energy Conversion Engineering Conference, 71-21 Aug. 2003, Portsmouth, VA, USA; Original contains color illustrations
Contract(s)/Grant(s): WBS 22-336-33-01-05
Report No.(s): NASA/TM-2003-212513; E-14073; NAS 1.15:212513; AIAA Paper 2003-5999; No Copyright; Avail: CASI; A03, Hardcopy

This paper discusses the on-orbit performance and performance degradation of the International Space Station P6 solar array wings (SAWs) from the period of December 2000 through February 2003. Data selection considerations and data reduction methods are reviewed along with the approach for calculating array performance degradation based on measured string shunt current levels. Measured degradation rates are compared with those predicted by the computational tool SPACE and prior degradation rates measured with the same SAW technology on the Mir space station. Initial results show that the measured SAW short-circuit current is degrading 0.2 to 0.5 percent per year. This degradation rate is below the predicted rate of 0.8 percent per year and is well within the 3 percent estimated uncertainty in measured SAW current levels. General contributors to SAW degradation are briefly discussed.
Author
Solar Arrays; International Space Station; Electric Potential

20030068367 National Renewable Energy Lab., Golden, CO
Eighth Workshop on Crystalline Silicon Solar Cell Materials and Processes. Summary Discussion Sessions
Swanson, D.; Sinton, R.; Stavola, M.; Tan, T.; Sopori, B.; Nov. 1998; 20 pp.; In English
Report No.(s): DE2003-7099; NREL/CP-520-25855; No Copyright; Avail: Department of Energy Information Bridge

The eighth workshop was attended by 114 scientists and technologists in the photovoltaic (PV) and microelectronics fields, making it the best-attended workshop to date. The popularity of the workshop stem from its scientific content, which emphasizes the fundamental aspects of science relevant to the industry problems, and the organizational format, which emphasizes discussions. With it updated tit and theme matching the issues at hand, the workshop appears to be particularly satisfying to industry. This year the title of the workshop was changed to the eighth Workshop on Crystalline Silicon Solar Cell Materials and Processes, aimed at emphasizing the increasing need to apply defect-engineering concepts in solar cell processing.
NTIS
Solar Cells; Microelectronics; Crystallinity

20030068377 New Jersey Inst. of Tech., Newark, NJ, USA
Novel Membrane and Device for Direct Contact Membrane Distillation Based Desalination Process
Sirkar, K. K.; Qin, Y.; Mar. 2001; 68 pp.; In English
Report No.(s): PB2003-104576; No Copyright; Avail: CASI; A04, Hardcopy

Direct contact membrane distillation (DCMD) and vacuum membrane distillation (VMD) of brine for desalination suffer from long-term flux decay due to membrane pore wetting and low water flux due to poor transport coefficients in the hot brine. Preliminary studies were carried out to address these problems. To prevent pore wetting, modules having an ultrathin microporous silicone coating on the surfaces of hydrophobic porous polypropylene hollow fibers were employed. Using a parallel flow Module 4 and high water velocity yielded a water flux of 15 kg sq. m./2-h at 91 degrees in VMD. There was no pore wetting even after a cumulative experimental duration of 1000 hours. In DCMD and VMD, a radial cross flow module and uncoated fibers yielded low water vapor fluxes. A large rectangular module having fibers with a nonporous coating also yielded low water vapor flux in DCMD. Conductive heat loss was substantial in the fine fibers; the cross flow velocity was very small in the large module where the hydrophobic fluoropolymer coating hindered water permeation much more than that in Module 4. Large fiber diameter and wall thickness, silicone coating and higher cross flow velocity are expected to substantially enhance the water vapor flux.
NTIS
Distillation; Membranes; Desalinization

20030068414 Colorado State Univ., Fort Collins, CO, USA
Device Physics of Thin-Film Polycrystalline Cells and Modules
Sites, J. R.; Apr. 1999; 62 pp.; In English
Report No.(s): DE2003-6805; No Copyright; Avail: Department of Energy Information Bridge

The results of the subcontract effort included progress in understanding CdTe and Cu(In1-xGax)Se2 based solar cells, in developing additional measurement and analysis techniques at the module level, and in strengthening collaboration within the thin-film polycrystalline solar-cell community. A major part of the CdTe work consisted of elevated-temperature stress tests to determine fabrication and operation conditions that minimize the possibility of long-term performance changes. Other CdTe studies included analysis of the back-contact junction, complete photon accounting, and the tradeoff with thin CdS between photocurrent gain and voltage loss. The Cu(In1-xGax)Se2 studies included work on the role of sodium in enhancing performance, the conditions under which conduction-band offsets affect cell performance, the transient effects of cycling between light and dark conditions, and detailed analysis of several individual series of cells. One aspect of thin-film module analysis has been addressing the differences in approach needed for relatively large individual cells made without grids. Most work, however, focused on analysis of laser scanning data, including defect signatures, photocurrent/shunting separation, and the effects of forward bias or high-intensity light. Collaborations with other labs continued on an individual basis, and starting in 1994, through the national R & D photovoltaic teams. Colorado State has been heavily involved in the structure and logistics of both the CdTe and CIS teams, as well as making, frequent technical contributions in both areas.
NTIS
Thin Films; Solar Cells; Cadmium Tellurides

20030068529 Kobe Steel Ltd., Japan
Ultraviolet Sensors Using Highly-Oriented Diamond Films
Hayashi, Kazushi; Tachibana, Takeshi; Yokota, Yoshihiro; Kobashi, Koji; Achard, Jocelyn; Gicquel, Alix; Olivero, Charles; Castex, Marie-Claude; Treshchalov, Alexey; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 130-135; In English; See also 20030068525; Original contains color illustrations; No Copyright; Avail: CASI; A02, Hardcopy

Ultraviolet sensors were fabricated using undoped, highly oriented diamond (HOD) films. The sensors have a pair of interdigited electrodes of Pt or Al with the gap length of 5, 10 and, 15 microns on the HOD surfaces. Both stationary and temporal responses to irradiations of ultraviolet (UV) lights from a deuterium lamp and an ArF excimer laser (193 nm) were measured. It was found that the sensors possessed 'solar-blind' property. Namely, the output signal due to a dye laser irradiation (313 nm) was only 1 % of that of the ArF laser irradiation. It was also found that the output signal due to the ArF laser irradiation well followed the incident laser pulse shape within a few nano-seconds. It was thus demonstrated that UV sensors made of HOD films can be practically used as solar-blind, robust UV laser power monitors.
Author
Electrodes; Diamond Films; Rare Gas-Halide Lasers; Laser Outputs

20030068543 Nanyang Technological Univ., Singapore
Characterization and Field Emission Properties of SWNTS and MWNTS
Wang, Sigen; Zhang, Qing; Yoon, S. F.; Ahn, J.; Yang, D. J.; Wang, Q.; Li, J. Q.; Zhou, Q.; Tian, J. Z.; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 95; In English; See also 20030068525; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

Carbon nanotubes have been rapidly recognized as one of the most promising electron field emitters ever since the first emission experiments reported in 1995, due to their unique structure and properties such as high aspect ratio, small radius of curvature at their tips, high mechanical strength and high chemical strength. In this paper, single-walled nanotubes (SWNTs) and multi-walled nanotubes (MWNTs) were characterized using scanning electron microscopy, transmission electron microscopy and Raman spectroscopy. Electron field emission from these SWNTs and MWNTs was measured. The experimental results show that the field emission property of MWNTs is better than that of SWNTs. The field emission mechanisms were also discussed.
Author
Carbon Nanotubes; Electron Emission; Field Emission; High Aspect Ratio

20030068544 Surrey Univ., Guildford, UK

Spatially Resolved Analysis of the Electronic Properties of WS2-Coated Carbon Nanotubes Using EELS in a TEM

Stolojan, V.; Goringe, M. J.; Silva, S. R. P.; Whitby, R. L. D.; Walton, D. R. M.; Hsu, W. K.; Kroto, H. W.; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 96-100; In English; See also 20030068525; Original contains black and white illustrations

Contract(s)/Grant(s): GR/N36073/01; No Copyright; Avail: CASI; A01, Hardcopy

Using the line focusing properties of the Gatan Imaging Filter (GIF) fitted to a transmission electron microscope (TEM), it is possible to extract electron energy loss (EEL) spectra with sub-nanometre spatial resolution from interfaces, whilst still maintaining parallel illumination. This non-contact technique allows for the investigation of the electronic properties of heterojunctions on a nanometre and sub-nanometre scale. Here we investigate the dielectric properties of the tungsten disulfide coating of a multi-walled carbon nanotube (MWCNT), by examining the change in the plasmon energy as a function of the coating s thickness. We show that for coating layer thicknesses above 5 monolayers (approx. 3.1 nm), there is a change in the plasmon region of the EEL spectra across the interface that indicates a change in the dielectric properties.

Author

Spatial Resolution; Carbon Nanotubes; Energy Dissipation; Electron Microscopes

20030068606 Marshall Univ., Huntington, WV, USA

On the Calculation of the Figure of Merit for Carbon Nanotubes Based Devices

Vaseashta, A.; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 106; In English; See also 20030068525; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

The dimensionality of a system has a profound influence on its physical behavior. With advances in technology over the past few decades, it has become possible to fabricate and study reduced-dimensional systems in which electrons are strongly confined in one or more dimensions. In the case of 1-D electron systems, most of the results, such as conductance quantization, have been explained in terms of non-interacting electrons. In contrast to the cases of 2D and 3D systems, the question of what roles electron-electron interactions play in real 1-D systems has been difficult to address, because of the difficulty in obtaining long, relatively disorder free 1-D wires. Since their first discovery and fabrication in 1991, carbon nanotubes (CNTs) have received considerable attention because of the prospect of new fundamental science and many potential applications. Hence, it has been possible to conduct studies of the electrons in 1-D. Carbon nanotubes are of considerable technological importance due to their excellent mechanical, electrical, and chemical characteristics. The potential technological applications include electronics, opto-electronics and biomedical sensors. The applications of carbon nanotubes include quantum wire interconnects, diodes and transistors for computing, capacitors, data storage devices, field emitters, flat panel displays and terahertz oscillators. One of the most remarkable characteristics is the possibility of bandgap engineering by controlling the microstructure. Hence, a pentagon-heptagon defect in the hexagonal network can connect a metallic to a semiconductor nanotube, providing an Angstrom-scale hetero-junction with a device density approximately 10(exp 4) times greater than present day microelectronics. Also, successfully contacted carbon nanotubes have exhibited a large number of useful quantum electronic and low dimensional transport phenomena, such as true quantum wire behaviors, room temperature field effect transistors, room temperature single electron transistors, Luttinger-liquid behavior, the Aharonov Bohm effect, and Fabry-Perot interference effects. Hence it is evident that CNT can be used for a variety of applications. To use CNT based devices, it is critical to know the relative advantage of using CNTs over other known electronic materials. The figure of merit for CNT based devices is not reported so far. It is the objective of this investigation to calculate the figure of merit and present such results. Such calculations will enable researchers to focus their research for specific device designs where CNT based devices show a marked improvement over conventional semiconductor devices.

Author

Semiconductor Devices; Elementary Particle Interactions; Electrons; Energy Gaps (Solid State); Nanostructure Growth

45
ENVIRONMENT POLLUTION

Includes atmospheric, water, soil, noise, and thermal pollution.

20030067747 Montana Univ., Missoula, MT

New and Improved Methods for Monitoring Air Quality and the Terrestrial Environment

Bromenshenk, Jerry J.; May 2001; 211 pp.; In English; Original contains color illustrations

Report No.(s): AD-A414740; DAMD17-95-C-5072; No Copyright; Avail: CASI; A10, Hardcopy

Honey bees (Apis mellifera L.) are multi-media monitors of chemical exposures and biotic effects. This six-year project has developed an automated system to assess in real-time colony behavioral responses to stressors, both anthropogenic and natural, including inclement weather. It also addressed chemical exposures by measuring the concentrations of volatile and semi-Volatile organic chemicals in ambient air and the air inside beehives, persistent pesticides and PCBs in bees and pollen, and radionuclides in bees and pollen. The resultant chemical data set includes locations throughout the Canal Creek, Old 0 Field, Bush River, J Field, and D Field areas of APO. It also includes off-post sites positioned along transects extending into Baltimore, Harford, and Cecil counties, with additional reference/test sites at Churchville and Worten's Point on the Eastern Shore of Chesapeake Bay. This final technical report provides: 1) a statistical approach for processing honey bee population dynamics data, 2) results of calibration trials for real-time monitoring of colony flight activity, and 3) the chemical exposure/fate data in a comprehensive, searchable database for use by APG installation restoration project managers.
DTIC
Air Quality; Statistical Analysis; Calibrating

20030068159 Texas Univ., Austin, TX, USA
New Strategies for Designing Inexpensive but Selective Bioadsorbants for Environmental Pollutants: Selection of Specific Ligands and their Cell Surface Expression
Iverson, B.; 2002; 6 pp.; In English
Report No.(s): DE2003-13501; No Copyright; Avail: Department of Energy Information Bridge

Progress for the last twelve months has revolved around setting up our antibody engineering and surface display system for use with a metal-complex binding antibody. We have isolated genes for the V regions of the heavy and light chains for the Ru(bpy)3 specific monoclonal AC1106 (Shreder, K S., Hariman, A., and Iverson, B.L., J. Am. Chem. Soc. 1996, 118, 3192-3201). This antibody binds Ru(bpy), derivatives with better than nanomolar affinity, and will serve as our generic metalcomplex binding pocket. Cloning antibody genes from hybridomas is complicated by the fact that primers must be found that amplify the particular heavy and light chain genes in the hybridoma of interest. Antibody gene amplification primers are generally designed to amplify antibody repertoires from lymphocyte mRNA isolated from animals. While cloning repertoires from animals is routinely successful due to the diverse population of target m RNA, hybridomas have a single target sequence. Therefore, multiple primers and conditions must be tried before the correct primer combination is identified.
NTIS
Antibodies; Ligands; Cells (Biology); Gene Expression; Molecular Structure; Radioactive Wastes; Environment Pollution; Adsorbents

20030068317 Federal Aviation Administration, Cambridge, MA, USA
Draft Guidelines for the Measurement and Assessment of Low-Level Ambient Noise
Fleming, G. G.; Roof, C. J.; Read, D. R.; Mar. 09, 1998; 100 pp.; In English
Report No.(s): PB2003-104868; DTS-34-FA865-LR1; No Copyright; Avail: CASI; A05, Hardcopy

This document describes an ambient noise measurement protocol, a detailed methodology for characterizing ambient noise in lowlevel environments such as the National Parks. It presents definitions of terminology useful for understanding the measurement and assessment guidelines. Also included are a general overview, an historical perspective, and a statement of purpose and objective. Specific details of characterizing a study areas ambient noise are outlined, including measurement site selection, instrumentation, and general field measurement procedures. Particular attention is given to the data reduction and analysis methodology, including guidance on assigning actual measured ambient noise to all specific locations within a study area. Proposed field testing of the methodology and subsequent refinement are also discussed. Additionally, specifics on a low-level noise measurement system developed by the Volpe Center Acoustics Facility are included.
NTIS
Noise Measurement; Ambience; Noise (Sound)

20030068940 California Dept. of Health Services, Sacramento, CA, USA
California Painters Project. Helping Small Business Work Safely with Lead. Occupational Lead Poisining Prevention Program. California Department of Health Services
Coyle, P.; Merideth, E.; Smith, M.; Sampton, L.; Feb. 1998; 630 pp.; In English
Report No.(s): PB2003-104585; No Copyright; Avail: CASI; A99, Hardcopy

The Occupational Lead Poisoning Prevention Program (OLPPP) of the California Department of Health Services (CDHS) provides statewide preventive services aimed at reducing the occurrence of work-related lead poisoning. Its activities include:

managing the Occupational Blood Lead Registry; investigating serious cases of lead poisoning in workers; developing educational materials; educating workers, employers, and health professionals; and conducting interventions targeted to specific high risk industries. In October of 1993, OLPPP initiated the California Painters Project (CPP). The purpose of the Project was four-fold: first, to develop and implement a model lead poisoning prevention strategy and evaluate it for its effectiveness with small to medium-sized painting contractors involved in residential and commercial painting activities; second, to develop a step-by-step employer compliance assistance manual; third to generate information on the resources required, problems encountered, and the feasibility and efficacy of the model, and to make recommendations for revisions; fourth, to assess the risk for lead poisoning among a painting workforce engaged in activities that disturb lead-based paint. NTIS

Medical Services; Lead Poisoning

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*.

20030067741 Iowa Univ., Iowa City, IA, USA

Spatiotemporal Variability and Propagation of Equatorial Noise Observed by Cluster

Santolik, O.; Pickett, J. S.; Gurnett, D. A.; Maksimovic, M.; Cornilleau-Wehrlin, N.; Journal of Geophysical Research; 2002; ISSN 0148-0227; Volume 107, No. A12, pp. 43-1 - 43-8; In English

Contract(s)/Grant(s): NAG5-9974; GACR-205/01/1064; Copyright; Avail: Other Sources

We report a multipoint case study of the electromagnetic equatorial noise observed by the Cluster project. High-resolution data were measured in three close points in space located in the morning sector of the outer plasmasphere. We demonstrate a narrow latitudinal extent of the emissions with a typical width of 2 degrees, centered near the minimum-B equator. Power spectra recorded by the different satellites show a complex structure of emission lines whose relative intensities and positions vary at timescales of 1-2 min and/or at spatial scales of tens of wavelengths. These lines do not match harmonics of the local proton cyclotron frequency, as it would be expected if the waves are generated by energetic ions and observed near the source region. We bring observational evidence that the waves propagate with a significant radial component and thus can propagate from a distant generation region located at different radial distances where ion cyclotron frequencies match the observed fine structure.

Author

Cyclotron Frequency; Electromagnetic Noise; Noise Propagation; Cluster Mission; Equators; Temporal Distribution

20030067823 Army Research Lab., White Sands Missile Range, NM, USA

Atmospheric Surface Layer Characterization: Preliminary Desert Lapse Rate Study 22-25 August 2000

Elliott, Doyle S.; Vaucher, Gail; Yarbrough, Jimmy; Quintis, David; May 2003; 30 pp.; In English

Report No.(s): AD-A414778; ARL-TR-2994; No Copyright; Avail: CASI; A03, Hardcopy

Results of the August 2000 Desert Lapse Rate (DLR) Experiment are presented. The DLR Experiment was performed to document the night-to-day transition effects on the desert Atmospheric Surface Layer (ASL). During the DLR Experiment, simultaneous 32 m and 2 m thermodynamic and wind data were gathered 2 hrs prior to, through 2 hrs after sunrise. Solar radiation data were also gathered over the Experimental Period. A GPS radiosonde was launched at the beginning of the atmospheric neutral event after sunrise to determine the depth of the isothermal layer. Lapse rate changes characterized the transition of the Night-Day lower-atmospheric Chihuahuan Desert conditions and are presented in the results.

DTIC

Lapse Rate; Atmospheric Physics

20030067837 Iowa Univ., Iowa City, IA, USA

Wave and Particle Interactions in the High and Low-Altitude Auroral Region During Rising Solar Activity

Gurnett, Donald A.; Menietti, J. D.; [2003]; 5 pp.; In English

Contract(s)/Grant(s): NAG5-9561; No Copyright; Avail: CASI; A01, Hardcopy

The project has resulted in four separate investigations, which are each in various stages of publication in the refereed scientific journals. The first investigation was of the generation of electrostatic electron cyclotron waves observed by the Polar spacecraft throughout the auroral regions, dayside cusp, and polar magnetosphere. We have since discovered that these waves

are also present within the magnetopause and magnetosheath, which is one of the topics of a second study, entitled: 'Polar observations of plasma waves in and near the dayside magnetopause/magnetosheath.' A third study of plasma waves focussed on kilometric continuum (KC) emission. This work is reported in a paper entitled 'Near-source and Remote Observations of Kilometric Continuum Radiation From Multi-spacecraft Observations'.The final investigation of this program concerns the possible transverse heating of auroral ions by impulsive wave structures. We summarize that substantial transverse ion heating has already occurred at lower altitudes. Abstracts of the above four studies are included in the Appendix to this final report. Derived from text

Auroral Zones; Solar Activity; Particle Interactions; Wave Interaction

20030067918 Scripps Institution of Oceanography, La Jolla, CA, USA

Survival of Amino Acids in Micrometeorites During Atmospheric Entry

Glavin, Daniel P.; Bada, Jeffrey L.; January 2003; 11 pp.; In English; Copyright; Avail: Other Sources

The delivery of amino acids by micrometeorites to the early Earth during the period of heavy bombardment could have been a significant source of the Earth's prebiotic amino acid inventory provided that these organic compounds survived atmospheric entry heating. To investigate the sublimation of amino acids from a micrometeorite analog at elevated temperature, grains from the CM-type carbonaceous chondrite Murchison were heated to 550 C inside a glass sublimation apparatus (SA) under reduced pressure. The sublimed residue that had collected on the cold finger of the SA after heating was analyzed for amino acids by HPLC. We found that when the temperature of the meteorite reached approx. 150 C, a large fraction of the amino acid glycine had vaporized from the meteorite, recondensed onto the end of the SA cold finger, and survived as the rest of the grains heated to 550 C. alpha-Aminoisobutryic acid and isovaline, which are two of the most abundant non-protein amino acids in Murchison, did not sublime from the meteorite and were completely destroyed during the heating experiment. Our experimental results suggest that sublimation of glycine present in micrometeorite grains may provide a way for this amino acid to survive atmospheric entry heating at temperatures less than 550 C; all other amino acids apparently are destroyed. Key Words: Amino acids-Exogenous delivery-Micrometeorites-Sublimation.

Author

Amino Acids; Micrometeorites; Aerodynamic Heating; Survival; Atmospheric Entry

20030068028 Alaska Univ., Fairbanks, AK, USA, Academy of Sciences (Russia), Magadan, Russia

Russian-US Partnership to Study the 23-km-diameter El'gygtgyn Impact Crater, Northeast Russia

Sharpton, Virgil L.; Minyuk, Pavel S.; Brigham-Grette, Julie; Glushkova, Olga; Layer, Paul; Raikevich, Mikhail; Stone, David; Smirnov, Valdimir; [2002]; 11 pp.; In English

Contract(s)/Grant(s): NAG5-8722; No Copyright; Avail: CASI; A03, Hardcopy

El'gygytgyn crater, located within Eastern Siberia, is a Pliocene-aged (3.6 Ma), well-preserved impact crater with a rim diameter of roughly 23 km. The target rocks are a coherent assemblage of crystalline rocks ranging from andesite to basalt. At the time of impact the region was forested and the Arctic Ocean was nearly ice-free. A 15-km lake fills the center of the feature and water depths are approximately 175 m. Evidence of shock metamorphism, -- including coesite, fused mineral glasses, and planar deformation features in quartz -- has been reported. This feature is one of the youngest and best preserved complex craters on Earth. Because of its remote Arctic setting, however, El gygytgyn crater remains poorly investigated. The objectives of this three-year project are to establish and maintain a research partnership between scientists from Russia and the USA interested in the El gygytgyn crater. The principal institutions in the U.S. will be the Geophysical Institute, University of Alaska Fairbanks and the University of Massachusetts Amherst. The principal institution in Russia will be the North East Interdisciplinary Scientific Research Institute (NEISRI), which is the Far-East Branch of the Russian Academy of Science. Three science tasks are identified for the exchange program: (1) Evaluate impactite samples collected during previous field excursions for evidence of and level of shock deformation. (2) Build a high-resolution digital elevation model for the crater and its surroundings using interferometric synthetic aperture radar techniques on JERS-1, ERS-1, ERS-2, and/or RadarSat range-doppler data. (3) Gather all existing surface data available from Russian and U.S. institutions (DEM, remote sensing image data, field-based lithological and sample maps, and existing geophysical data) and assemble into a Geographic Information Systems database.

Author

Meteorite Craters; Impact Melts; Deformation; Digital Elevation Models; Geographic Information Systems; Data Bases

20030068108 NASA Marshall Space Flight Center, Huntsville, AL, USA

Atic Experiment: Flight Data Processing

Ahn, H. S.; Adams, J. H.; Bashindzhagyan, G.; Batkov, K. E.; Chang, J.; Christl, M.; Fazely, A. R.; Ganel, O.; Gunasingha, R. M.; Guzik, T. G., et al.; [2003]; 1 pp.; In English; 28th International Cosmic Ray Conference, 31 Jul. - 7 Aug. 2003, Tsukuba, Japan; No Copyright; Avail: Other Sources; Abstract Only

The Advanced Thin Ionization Calorimeter (ATIC) is a balloon borne experiment to measure the composition and energy spectra of Z = 1 to 28 cosmic rays over the energy range approx. 30 GeV - 100 TeV. The instrument consists of a fully active 320-crystal Bismuth Germanate (BGO) calorimeter, 202 scintillator strips in 3 hodoscopes interleaved with a graphite target, and a 4480-pixel silicon matrix charge detector. ATIC has had two successful Long Duration Balloon flights from McMurdo, Antarctica: from 12/28/00 to 01/13/01 and from 12/29/02 to 01/18/03. We have developed the ATIC Data Processing System (ADPs), which is an Object Oriented data processing program based on ROOT. In this paper, we describe the processing scheme used in handling the flight data, especially the calibration method and the event reconstruction algorithm.

Author

Data Processing; Flight Recorders; Cosmic Rays; Scintillation Counters

20030068122 NASA Marshall Space Flight Center, Huntsville, AL, USA

A Ground-based UV Light Source for the Euso Mission

Adams, J. H.; Christl, M. J.; [2003]; 1 pp.; In English; 28th International Cosmic Ray Conference, 31 Jul.-7 Aug. 2003, Tsukuba, Japan; No Copyright; Avail: Other Sources; Abstract Only

The Extreme Universe Space Observatory (EUSO) mission will measure the uorescence signal produced by Extensive Air Showers (EAS). To determine the intrinsic shower luminance and hence the energy of the incident cosmic ray, a correction must be made for attenuation in the atmosphere. The correction will be determined on an event-by-event basis by atmospheric sounding with a LIDAR. We report here on a 'ground truth' concept to verify EUSO's measurements of intrisic shower luminance.

Author

Ground State; Cosmic Ray Showers; Light Sources

20030068276 Yokohama National Univ., Japan

Prebiotic Synthesis from CO Atmospheres: Implications for the origins of life

Meyer, Michael, Technical Monitor; Miyakawa, Shin; Yamanashi, Hiroto; Kobayashi, Kensei; Cleaves, H. James; Miller, Stanley L.; PNAS Early Edition; [2002]; 9 pp.; In English

Contract(s)/Grant(s): NAG5-4546; Copyright; Avail: Other Sources

Most models of the primitive atmosphere around the time life originated suggest that the atmosphere was dominated by carbon dioxide, largely based on the notion that the atmosphere was derived via volcanic outgassing, and that those gases were similar to those found in modern volcanic effluent. These models tend to downplay the possibility of a strongly reducing atmosphere, which had been thought to be important for prebiotic synthesis and thus the origin of life. However, there is no definitive geologic evidence for the oxidation state of the early atmosphere and bioorganic compounds are not efficiently synthesized from CO2 atmospheres. In the present study, it was shown that a CO-CO2-N2-H2O atmosphere can give a variety of bioorganic compounds with yields comparable to those obtained from a strongly reducing atmosphere. Atmospheres containing carbon monoxide might therefore have been conducive to prebiotic synthesis and perhaps the origin of life. CO-dominant atmospheres could have existed if the production rate of CO from impacts of extraterrestrial materials were high or if the upper mantle had been more reduced than today.

Author

Atmospheric Models; Biological Evolution; Carbon Monoxide; Synthesis (Chemistry)

20030068415 NASA Marshall Space Flight Center, Huntsville, AL, USA

IMAGE Observations of Plasmasphere/Ring Current Interactions

Gallagher, D. L.; Adrian, M. L.; Perez, J.; Sandel, B. R.; [2003]; 1 pp.; In English; International Union of Geodesy and Geophysics, 8 Jul. 2003, Sapporo, Japan; No Copyright; Avail: Other Sources; Abstract Only

Evidence has been found in IMAGE observations that overlap of the plasmasphere and the ring current may lead to enhanced loss of plasma into the ionosphere. It has long been anticipated that this mixing of plasma leads to coupling and resulting consequences on both populations. Wave generation, pitch angle scattering, and heating are some of the

consequences that are anticipated. IMAGE plasmasphere ring current, and auroral observations will be presented and used to explore these interactions and their effects.
Author
Plasmasphere; Plasmas (Physics); Ring Currents; Earth Ionosphere; Losses

47
METEOROLOGY AND CLIMATOLOGY

Includes weather observation forecasting and modification.

20030067774 Air War Coll., Maxwell AFB, AL
Weather Operations in the Transformation Era
Lanicci, John M.; Mar. 2003; 36 pp.; In English
Report No.(s): AD-A414781; No Copyright; Avail: CASI; A03, Hardcopy

In Weather Operators in the Transformation Era, Col. John M. Lanicci, USAF, takes a compelling look at future weather operations. His hypothesis Is that a consolidated battlespace picture Integrates both natural and man-made elements, which is totally consistent with USAF transformation efforts. He points out that the way ahead is easier said than done and offers several cogent reasons why the weather operations portion of Information-in-warfare has not caught up with current USAF doctrine. One such example is our historical tendency to look at weather as a somewhat Isolated, tactical problem. Significant advances In information technology and advent of effects-based operations are propelling the USAF weather community away from traditional, single-Inject stand-up briefings towards continuously updated advice to war fighters at every step of campaign/ mission planning and execution. This technological momentum will make It necessary to fundamentally change data collection, analysis, prediction, and product tailoring. The author outlines these changes In a concept called weather, intelligence, surveillance, and reconnaissance (WISR), a term first used by the Air Staff to describe the total Integration of natural and man-made environments for predictive battlespace awareness (PBA). The WISR concept Is based on substantially Increasing the volume of weather data collected In-theater by using the same airborne assets being proposed for PBA, persistent ISR, and time-critical targeting. It proposes the creation of a four-dimensional database that can be used to integrate the natural environment Into the common operating picture. The WISR concept also advocates transmitting real-time weather Information to the cockpit as a means to optimize the kill chain by allowing rapid redirecting of sorties based on continuously updated weather information.
DTIC
Meteorological Parameters; Mission Planning

20030067902 NASA Glenn Research Center, Cleveland, OH, USA
Spatial Analysis of Great Lakes Regional Icing Cloud Liquid Water Content
Ryerson, Charles C.; Koenig, George G.; Melloh, Rae A.; Meese, Debra A.; Reehorst, Andrew L.; Miller, Dean R.; July 2003; 18 pp.; In English
Contract(s)/Grant(s): WBS 22-708-20-06
Report No.(s): NASA/TM-2003-212452; AIAA-2001-0394; NAS 1.15:212452; E-13994; Copyright; Avail: CASI; A03, Hardcopy

Abstract Clustering of cloud microphysical conditions, such as liquid water content (LWC) and drop size, can affect the rate and shape of ice accretion and the airworthiness of aircraft. Clustering may also degrade the accuracy of cloud LWC measurements from radars and microwave radiometers being developed by the government for remotely mapping icing conditions ahead of aircraft in flight. This paper evaluates spatial clustering of LWC in icing clouds using measurements collected during NASA research flights in the Great Lakes region. We used graphical and analytical approaches to describe clustering. The analytical approach involves determining the average size of clusters and computing a clustering intensity parameter. We analyzed flight data composed of 1-s-frequency LWC measurements for 12 periods ranging from 17.4 minutes (73 km) to 45.3 minutes (190 km) in duration. Graphically some flight segments showed evidence of consistency with regard to clustering patterns. Cluster intensity varied from 0.06, indicating little clustering, to a high of 2.42. Cluster lengths ranged from 0.1 minutes (0.6 km) to 4.1 minutes (17.3 km). Additional analyses will allow us to determine if clustering climatologies can be developed to characterize cluster conditions by region, time period, or weather condition. Introduction
Author
Cloud Physics; Ice Clouds; Weather; Drop Size; Moisture Content

20030067906 Colorado Univ., Boulder, CO, USA

Retrieval of Hydrometeor Drop Size Distributions from TRMM Field Campaign Profiler Doppler Velocity Spectra Observations

Williams, Christopher R.; Gage, Kenneth S.; August 20, 2003; 8 pp.; In English

Contract(s)/Grant(s): NAG5-9753; CU Proj. 1532925; No Copyright; Avail: CASI; A02, Hardcopy

Consistent with the original proposal and work plan, this project focused on estimating the raindrop size distributions (DSDs) retrieved from vertically pointing Doppler radar profilers and analyzing the relationship of the retrieved DSDs with the dynamics of the precipitation processes. The first phase of this project focused on developing the model to retrieve the DSD from the observed Doppler velocity spectra. The second phase used this model to perform DSD retrievals from the profiler observations made during the TRMM Ground Validation Field Campaigns of TEFLUN-B, TRMM-LBA, and KWAJEX. The third phase of this project established collaborations with scientists involved with each field campaign in order to validate the profiler DSD estimates and to enable the profiler retrievals to be used in their research. Through these collaborations, the retrieved DSDs were placed into context with the dynamical processes of the observed precipitating cloud systems.

Author

Hydrometeors; Drop Size; Size Distribution

20030067938 Alabama Univ., Huntsville, AL, USA

Longwave Radiative Forcing of Saharan Dust Aerosols Estimated from MODIS, MISR and CERES Observations on Terra

Zhang, Jiang-Long; Christopher, Sundar A.; [2003]; 13 pp.; In English

Contract(s)/Grant(s): NCC8-200; No Copyright; Avail: CASI; A03, Hardcopy

Using observations from the Multi-angle Imaging Spectroradiometer (MISR), the Moderate Resolution Imaging Spectroradiometer (MODIS), and the Clouds and the Earth's Radiant Energy System (CERES) instruments onboard the Terra satellite; we present a new technique for studying longwave (LW) radiative forcing of dust aerosols over the Saharan desert for cloud-free conditions. The monthly-mean LW forcing for September 2000 is 7 W/sq m and the LW forcing efficiency' (LW(sub eff)) is 15 W/sq m. Using radiative transfer calculations, we also show that the vertical distribution of aerosols and water vapor are critical to the understanding of dust aerosol forcing. Using well calibrated, spatially and temporally collocated data sets, we have combined the strengths of three sensors from the same satellite to quantify the LW radiative forcing, and show that dust aerosols have a 'warming' effect over the Saharan desert that will counteract the shortwave 'cooling effect' of aerosols.

Author

Aerosols; Dust; Spectroradiometers; Radiative Transfer; Radiant Flux Density

20030067952 Desert Research Inst., Reno, NV, USA

In Situ Microphysical Observations in Support of the TRMM/KWAJEX Field Campaign

Hallett. John; [2002]; 5 pp.; In English

Contract(s)/Grant(s): NAG5-7973; No Copyright; Avail: CASI; A01, Hardcopy

This project encompasses development of concepts, field investigation techniques and analysis for processes of precipitation in tropical environments. The field work was primarily undertaken during the DC-8 campaign in Kwajelein during the summer of 2001; it was stymied by the inability of the PI to obtain participation in this primary field activity (the associate PI ably carried out the field work but direct involvement of the PI in the field was a major detraction for the subsequent analysis). Insight into the relevant meteorological processes was supplemented by data and investigations of the PI on the NASA DC-8 in CAMEX from Orlando in 1998 together with previous work in hurricane environments and also in laboratory studies on the formation and characteristics of ice at low temperatures.

Author

Tropical Regions; Precipitation; Ice; Hurricanes

20030067981 Naval Postgraduate School, Monterey, CA

A Numerical Investigation of Mesoscale Predictability

Beattie, Jodi C.; Mar. 2003; 95 pp.; In English; Original contains color illustrations

Report No.(s): AD-A414851; No Copyright; Avail: CASI; A05, Hardcopy

As mesoscale models increase in resolution there is a greater need to understand predictability on smaller scales. The predictability of a model is related to forecast skill. It is possible that the uncertainty of one scale of motion can affect the other

scales due to the nonlinearity of the atmosphere. Some suggest that topography is one factor that can lead to an increase of forecast skill and therefore predictability. This study examines the uncertainty of a mesoscale model and attempts to characterize the predictability of the wind field. The data collected is from the summer, when the synoptic forcing is relatively benign. Mesoscale Model 5 (MM5) lagged forecasts are used to create a three- member ensemble over a 12-hour forecast cycle. The differences in these forecasts are used to determine the spread of the wind field. Results show that some mesoscale features have high uncertainty and others have low uncertainty, shedding light on the potential predictability of these features with a mesoscale model. Results indicate that topography is a large source of uncertainty. This is seen in all data sets, contrary to other studies. The ability of the model to properly forecast the diurnal cycle also impacted substantially on the character and evolution of forecast spread. The persistent mesoscale features were represented reasonably well, however the detailed structure of these features had a fair amount of uncertainty.
DTIC
Numerical Analysis; Weather Forecasting; Meteorology; Wind Velocity; Velocity Distribution

20030067990 Westinghouse Savannah River Co., Aiken, SC, USA
Wind Climate Analyses for National Weather Service Stations in the Southeast
2003; In English
Report No.(s): DE2003-807913; WSRC-TR-2002-00515; No Copyright; Avail: National Technical Information Service (NTIS)

The purpose of this paper is to demonstrate the overall relationships of wind patterns for NWS stations in the Southeast. Since organized collection of wind data records in the NWS developed rapidly in conjunction with the expansion of commercial aviation after World War II there are now about 50 years of wind speed and direction data available for a large number of NWS stations in this area. In this study we used wind roses for relatively short time scales to show the progression of winds diurnally and monthly to span a typical year. The data used here consist of wind records from 13 National Weather Service Stations in the Southeastern U.S. for approximately 50-year periods. These 13 stations include Augusta (AGS), Athens (AHN), Atlanta (ATL), Columbus (CSG), Macon (MCN) and Savannah (SAV) Georgia; Columbia (CAE) and Charleston (CHS) South Carolina; Asheville (AVL), Charlotte (CLT), Raleigh (RDU), and Wilmington (ILM) North Carolina; and Jacksonville (JAX) Florida. The stations at Savannah (SAV) and Athens (AHN) Georgia had records of 50 and 45 years, respectively. The other stations had 50 or greater years of available data.
NTIS
Wind Measurement; Wind Direction; Weather Stations

20030067996 Northeast Consortium for Engineering Education, Port Royal, VA
Research by AFRL Scholars; June 1998-September 2000
Everett, Woodrow, Jr; Feb. 6, 2003; 5 pp.; In English
Contract(s)/Grant(s): F19628-98-C-0029; Proj-9993
Report No.(s): AD-A414873; AFRL-VS-TR-2003-1534; No Copyright; Avail: CASI; A01, Hardcopy

Five AFRL Scholars were appointed under task requirement notices to pursue projects supporting on-going research efforts at AFRL/VSB The scholars and the topics investigated included the following: Susan Triantafillou - 'A Lattice Boltzmann Model of Cloud-Forming Processes'; Anthony Midey -' The Role of Ion Chemistry in the Kinetic Control of Combustion Processes'; (Gary Lapham - 'A study of the Relationship between Gravity Waves and Stratospheric Turbulence'; Steven Pullins - 'The Hyperthermal Dynamics Associated with Meteoritic Materials'; Jennifer Lipson - 'Infrared Emissions from Reaction of Hydrocarbons with O Atoms'; Anthony Midey - The Role of Ion Chemistry in the Kinetic Control of Combustion Processes' (second year appointment) Reports documenting these investigations are available from DTIC.
DTIC
Turbulence; Combustion; Gravity Waves; Radiation Chemistry; Ionic Reactions

20030068011 Massachusetts Inst. of Tech., Cambridge, MA, USA
Use of GTE, Mozaic, Sonex, and UARS-MLS Data in Understanding Tropospheric Processes Critical to Model Development
Newell, Reginald E., Principal Investigator; June 9, 2003; 4 pp.; In English
Contract(s)/Grant(s): NAG1-2306
Report No.(s): MIT-6890805; No Copyright; Avail: CASI; A01, Hardcopy

During the first year we focused on the analysis of data collected on over 7600 commercial aircraft flights (the MOZAIC

program). The aim was to further our understanding of the fundamental dynamical processes that drive mesoscale phenomena in the upper troposphere and lower stratosphere, and their effects on the advection of passive scalars. Through these studies we made the following findings. 2001]: We derived the Kolmogorov equation for the third-order velocity structure function on an f-plane. We showed how the sign of the function yields the direction of the energy cascade. The remarkable linearity of the measured off diagonal third-order structure function was studied. We suggested that the Coriolis term, which appears explicitly in this equation, may be crucial in understanding the observed kinetic energy spectra at scales larger than 100 km, instead of the nonlinear advection term as previously assumed. Also, we showed that <epsilon> decreases with latitude for mid- to high-latitudes, and tabulated the values. Ozone concentration structure functions were calculated by restricting the data points to approximately isentropic pairings. In this way we were able to make comparisons with scalar advection theories. We found that, at even the largest scales, there was no evidence for the simple scaling predicted for smooth advection/diffusion. Derived from text

Troposphere; Atmospheric Models; Gas Composition; Data Processing

20030068016 Naval Postgraduate School, Monterey, CA

The California Coastal Jet: Synoptic Controls and Topographically Induced Mesoscale Structure

Cross, Patrick S.; Mar. 2003; 195 pp.; In English; Original contains color illustrations

Report No.(s): AD-A414824; No Copyright; Avail: CASI; A09, Hardcopy

The low-level jet along the coast of southern Oregon and California is examined in detail through an extensive data set and the application of COAMPS, a mesoscale model, for the purpose of improving forecasts in challenging littoral environments. The jet forms within the broad equatorward flow established by the pressure gradient between cool ocean and warm land. The inception of the jet along the coast is about 250 km south of the axis of a northeastward extension of the eastern North Pacific high, and the jet may extend equatorward and offshore for hundreds of kilometers. Wind magnitudes increase in association with a reorientation of the coastal surface pressure gradient such that an increased down-coast component exists. Within 200 kilometers of the coast, considerable diurnal and spatial variability are observed and predicted by the model. The frequently observed low-level high wind areas at specific locations along the coast are caused by the combined effects of supercritical expansion within the boundary layer and mountain wave-type flow above the marine layer over six coastal mountain areas in close proximity to the coast. While the expansion fan effects are localized near a coastal bend, it is the offshore extension of the mountain wave that accounts for the large spatial extent of the maximum wind areas offshore.

DTIC

Coasts; Mesoscale Phenomena; Topography; Jet Streams (Meteorology); California

20030068119 National Center for Atmospheric Research, Boulder, CO, USA

Structure of Subfilter-Scale Fluxes in the Atmospheric Surface Layer with Application to Large-Eddy Simulation Modelling

Sullivan, Peter P.; Horst, Thomas W.; Lenschow, Donald H.; Moeng, Chin-Hoh; Weil, Jeffrey C.; J. Fluid Mech.; 2003; Volume 482, pp. 101-139; In English

Contract(s)/Grant(s): NAG5-8839

Report No.(s): NCAR-1998-290; Copyright; Avail: Other Sources

In the atmospheric surface layer, the wavelength of the peak in the vertical velocity spectrum Lambda(sub omega), decreases with increasing stable stratification and proximity to the surface and this dependence constrains our ability to perform high-Reynolds-number large-eddy simulation (LES). Near the ground, the LES filter cutoff Delta(sub f) is comparable to or larger than Lambda(sub omega), and as a result the subfilter-scale (SFS) fluxes in LES are always significant and their contribution to the total flux grows with increasing stability. We use the three-dimensional turbulence data collected during the Horizontal Array Turbulence Study (HATS) field program to construct SFS fluxes and variances that are modelled in LES codes. Detailed analysis of the measured SFS motions shows that the ratio Lambda(sub omega)/Delta(sub f) contains the essential information about stratification, vertical distance above the surface, and filter size, and this ratio allows us to connect measurements of SFS variables with LES applications. We find that the SFS fluxes and variances collapse reasonably well for atmospheric conditions and filter widths in the range Lambda(sub omega)/Delta(sub f) = [0.2, 15]. The SFS variances are anisotropic and the SFS energy is non-inertial, exhibiting a strong dependence on the stratification, large-scale shear, and proximity to the surface. SFS flux decomposition into modified-Leonard, cross-, and Reynolds terms illustrates that these terms are of comparable magnitude and scale content at large Lambda(sub omega)/Delta(sub f). As Lambda(sub omega)/Delta(sub f) approaches 0, the SFS flux approaches the-ensemble-average flux and is dominated by the Reynolds term. Backscatter of energy from the SFS motions to the resolved fields is small in the bulk of the surface layer, less than 20% for

Lambda(sub omega)/Delta(sub f) less than 2. A priori testing of typical SFS models using the HATS dataset shows that the turbulent kinetic energy and Smagorinsky model coefficients Ck and Cs depend on Lambda(sub omega)/Delta(sub f) and are smaller than theoretical estimates based on the assumption of a sharp spectral cutoff filter in the inertial range. Ck and Cs approach zero for small Lambda(sub omega)/ Delta(sub f). Much higher correlations between measured and modelled SFS fluxes are obtained with a mixed SFS model that explicitly includes the modified-Leonard term. The eddy-viscosity model coefficients still retain a significant dependence on Lambda(sub omega)/Delta(sub f) with the mixed model. A dissipation model of the form epsilon = C(sub epsilon)E(sub s, sup 3/2)/Delta(sub f) is not universal across the range of Lambda(sub omega)/Delta(sub f) typical of atmospheric LES applications. The inclusion of a shear-stability-dependent length scale captures a large fraction of the variation in the eddy-viscosity and dissipation model coefficients.
Author
Atmospheric Stratification; Eddy Viscosity; Surface Layers; Large Eddy Simulation

20030068167 Massachusetts Inst. of Tech., Lexington, MA, USA
Evaluation of TDWR Range-Velocity Ambiguity Mitigation Techniques
Cho, J. Y. N.; Apr. 04, 2003; 68 pp.; In English
Report No.(s): PB2003-104213; ATC-310; No Copyright; Avail: CASI; A04, Hardcopy

Range and velocity ambiguities pose significant data quality challenges for the Terminal Doppler Weather Radar (TDWR). For typical pulse repetition frequencies (PRFs) of 1-2 kHz, the radar is subject to both range-ambiguous precipitation returns and velocity aliasing. Experience shows that these are a major contributor to failures of the system's wind shear detection algorithms. Here the authors evaluate the degree of mitigation offered by existing phase diversity methods to these problems. Using optimized processing techniques, the authors analyze the performance of two particular phase codes that are best suited for application to TDWRs-random and SZ(8/64) (Sachidananda and Zrinc', 1999)-in the protection of weak-trip power, velocity, and spectral width estimates. Results from both simulated and real weather data indicate that the SZ(8/64) code generally outperforms the random code, except for protection of 1st trip from 5th trip interference. However, the SZ code estimates require a priori knowledge of out-of-trip spectral widths for censoring. This information cannot be provided adequately by a separate scan with a Pulse Repetition Frequency (PRF) low enough to unambiguously cover the entire range of detectable weather, because then the upper limit of measurable spectral width is only about 2 m/s. For this reason the authors conclude that SZ phase codes are not appropriate for TDWR use.
NTIS
Doppler Radar; Wind Shear

20030068171 Massachusetts Inst. of Tech., Cambridge, MA, USA
Evaluation of Improved Pushback Forecasts Derived from Airline Ground Operations Data
Carr, Francis; Theis, Georg; Feron, Eric; Clarke, John-Paul; [2003]; 39 pp.; In English
Contract(s)/Grant(s): NCC2-1147; MIT-OSP-6890296; No Copyright; Avail: CASI; A03, Hardcopy

Accurate and timely predictions of airline pushbacks can potentially lead to improved performance of automated decision-support tools for airport surface traffic, thus reducing the variability and average duration of costly airline delays. One factor which affects the realization of these benefits is the level of uncertainty inherent in the turn processes. To characterize this inherent uncertainty, three techniques are developed for predicting time-to-go until pushback as a function of available ground-time; elapsed ground-time; and the status (not-started/in-progress/completed) of individual turn processes (cleaning, fueling, etc.). These techniques are tested against a large and detailed dataset covering approximately l0(exp 4) real-world turn operations obtained through collaboration with Deutsche Lufthansa AG. Even after the dataset is filtered to obtain a sample of turn operations with minimal uncertainty, the standard deviation of forecast error for all three techniques is lower-bounded away from zero, indicating that turn operations have a significant stochastic component. This lower-bound result shows that decision-support tools must be designed to incorporate robust mechanisms for coping with pushback demand stochasticity, rather than treating the pushback demand process as a known deterministic input.
Author
Evaluation; Forecasting; Predictions; Ground Operational Support System

20030068177 Los Alamos National Lab., NM
Developing Public Awareness for Climate Change: Support from International Research Programs
Barnes, F. J.; Clements, W. E.; Aug. 1997; 22 pp.; In English
Report No.(s): DE2003-304032; No Copyright; Avail: Department of Energy Information Bridge

Developing regional and local public awareness and interest in global climate change has been mandated as an important step for increasing the ability for setting policy and managing the response to climate change. In order to increase public awareness, the informal flow of information (through journalism, public meetings, and public relations efforts) as well as formal education in environmental issues and basic science has to become a top priority at international, regional and local scales. Both educational goals and the flow of public information can be supported by a careful strategy of requesting assistance from international and regional research programs that are targeting the key environmental concerns of the Pacific region.
NTIS
Climate Change; Education

20030068918 Meteorological Satellite Center, Kiyose, Japan
Monthly Report of the Meteorological Satellite Center: May 2003
May 2003; In English; In Japanese; Document files and Satellite data are recorded in either ASCII or shift JIS code; Full Disk Earth's Cloud Images are recorded in Bit-Map (BMP) format; Copyright; Avail: Other Sources

The CD-ROM concerning the May 2003 Monthly Report of the Meteorological Satellite Center (MSC) contains the observation data derived from the Geostationary Meteorological Satellite (GMS) of Japan and the Polar Orbital Meteorological Satellites operated by NOAA. The CD-ROM contains the following observation data: Full Disk Earth's Cloud Image; Cloud Image of Japan and its vicinity; Cloud Amount; Sea Surface Temperature; Cloud Motion Wind; Water Vapor Motion Wind; Equivalent Blackbody Temperature; OLR (Out-going Longwave Radiation), Solar Radiation; Snow and Ice Index; Orbit Data; Attitude Data; VISSR Image Data Catalog (Cartridge Magnetic Tape (CMT), Micro Film); TOVS (TIROS Operational Vertical Sounder) Vertical Profile of Temperature and Precipitable Water; and TOVS Total Ozone Amount.
Derived from text
Satellite Observation; Satellite Sounding; Atmospheric Sounding; Meteorological Parameters; Satellite Imagery; Japan

20030068938 NASA Langley Research Center, Hampton, VA, USA
Impact of High Resolution Water Vapor Cross-Sectional Data on Hurricane Forecasting
Kamineni, Rupa; Krishnamurti, T. N.; Ferrare, Richard A.; Ismail, Syed; Browell, Edward V.; Geophysical Research Letters; 2003; ISSN 0094-8276; Volume 30, No. 5, pp. 38-1 - 38-4; In English
Contract(s)/Grant(s): NAG8-1848; NAG8-1537; NSF ATM-01-08741; Copyright; Avail: Other Sources

This paper addresses the impact of moisture profile data sets derived from the Lidar Atmospheric Sensing Experiment (LASE) for the assimilation and forecasts of hurricanes. LASE is a vertical profiler for moisture measurements that was developed at NASA Langley Research Center. LASE was deployed on board the NASA DC-8 research aircraft and provided vertical profiles of moisture in a hurricane environment during the Convection and Moisture Experiment-4, which occurred in August and September 2001. In this preliminary study we show results from two types of experiments (with and without LASE data) that show improvements in track and intensity forecasts of hurricanes, Erin, Humberto and Gabrielle. When the LASE moisture profiles are assimilated, track errors are reduced by 100 km and intensity errors are reduced by 20-25% for 3 day forecasts.
Author
Water Vapor; Forecasting; Hurricanes

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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*.

20030067764 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Significant Dissipation of Tidal Energy in the Deep Ocean Inferred from Satellite Altimeter Data
Egbert, G. D.; Ray, R. D.; Nature; June 15, 2000; Volume 405, pp. 775-778; In English; Copyright; Avail: Other Sources

How and where the ocean tides dissipate their energy are longstanding questions that have consequences ranging from the history of the Moon to the mixing of the oceans. Historically, the principal sink of tidal energy has been thought to be bottom friction in shallow seas. There has long been suggestive however, that tidal dissipation also occurs in the open ocean through the scattering by ocean-bottom topography of surface tides into internal waves, but estimates of the magnitude of this possible sink have varied widely. Here we use satellite altimeter data from Topex/Poseidon to map empirically the tidal energy

dissipation. We show that approximately 10(exp 12) watts-that is, 1 TW, representing 25-30% of the total dissipation-occurs in the deep ocean, generally near areas of rough topography. Of the estimated 2 TW of mixing energy required to maintain the large-scale thermohaline circulation of the ocean, one-half could therefore be provided by the tides, with the other half coming from action on the surface of the ocean.
Author
Altimeters; Ocean Bottom; Poseidon Satellite; Energy Dissipation; Thermohaline Circulation

20030067816 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Estimates of M2 Tidal Energy Dissipation from TOPEX/Poseidon Altimeter Data
Egbert, Gary D.; Ray, Richard D.; Journal of Geophysical Research; [2001]; ISSN 0148-0227; Volume 106, No. C10, pp. 22,475-22,502; In English
Contract(s)/Grant(s): NSF OCE-96-33527; NSF OCE-98-19518
Report No.(s): Paper-2000JC000699; Copyright; Avail: Other Sources

Most of the tidal energy dissipation in the ocean occurs in shallow seas, as has long been recognized. However, recent work has suggested that a significant fraction of the dissipation, perhaps 1 TW or more, occurs in the deep ocean. This paper builds further evidence for that conclusion. More than 6 years of data from the TOPEX/Poseidon satellite altimeter are used to map the tidal dissipation rate throughout the world ocean. The dissipation rate is estimated as a balance between the rate of working by tidal forces and the energy flux divergence, computed using currents derived by least squares fitting of the altimeter data and the shallow water equations. Such calculations require dynamical assumptions, in particular about the nature of dissipation. To assess sensitivity of dissipation estimates to input assumptions, a large suite of tidal inversions based on a wide range of drag parameterizations and employing both real and synthetic altimeter data are compared. These experiments and Monte Carlo error fields from a generalized inverse model are used to establish error uncertainties for the dissipation estimates. Owing to the tight constraints on tidal elevation fields provided by the altimeter, area integrals of the energy balance are remarkably insensitive to required dynamical assumptions. Tidal energy dissipation is estimated for all major shallow seas (excluding individual polar seas) and compared with previous model and data-based estimates. Dissipation in the open ocean is significantly tnhanced around major bathymetric features, in a manner consistent with simple theories the generation of baroclinic tides.
Author
Tides; Energy Dissipation; Satellite Observation; Radio Altimeters; Oceans

20030067893 Texas Univ., Austin, TX, USA
Improvement in Geoid Models for Ocean Circulation Studies
Tapley, Byron D.; Chambers, Don P.; Poole, Steve; Ries, John c.; August 17, 2003; 5 pp.; In English
Contract(s)/Grant(s): NAG5-9163; No Copyright; Avail: CASI; A01, Hardcopy

At wavelengths of 500 km and longer, the GRACE GGM01 Model produces a significantly better marine geoid than any previous model. This conclusion follows from evaluating the geostrophic currents determined by combining the model with a mean sea surface from altimetry. The agreement with currents computed from a traditional hydrographic map is very close, which suggests that one of the primary missions of the TOPEX/POSEIDON mission, to determine the absolute dynamic ocean topography, may soon be met. This solution has been made available to the public at http://www.csr.utexs.edu/grace/gravity. The results reported in this paper have been presented at the 2003 EGS-AGU-EUG Joint Assembly. Two articles are currently being prepared for Geophysical Research Letters to summarize these results.
Derived from text
Geoids; Geophysics; Astronomical Models; Ocean Currents; Topography

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*.

20030067841 California Inst. of Tech., Pasadena, CA, USA, California Univ., La Jolla, CA, USA
[The Evolutionary Origin of Placodes and Neural Crest Cells]
Bronner-Fraser, Marianne; [2003]; 4 pp.; In English
Contract(s)/Grant(s): NAG2-1376; NAG2-1585; No Copyright; Avail: CASI; A01, Hardcopy

The long-term goal of this NASA-supported research is to understand the evolutionary origin of placodes and neural crest cells, with particular reference to evolution of the inner ear, and their evolutionary and developmental relationships. The cephalochordcate amphioxus, the closest living invertebrate relative of the vertebrates is used as a stand-in for the ancestral vertebrate. The research, which has supported one graduate student, Jr-Kai Yu, has resulted in ten publications by the Holland laboratory in peer-reviewed journals.
Derived from text
Evolution (Development); Ear; Vertebrates

20030067910 State Univ. of New York, New Paltz, NY, USA
Effect Of Simulated Microgravity On Activated T Cell Gene Transcription
Morrow, Maureen A.; [2003]; 3 pp.; In English
Contract(s)/Grant(s): NAG2-1379; No Copyright; Avail: CASI; A01, Hardcopy

Studies of T lymphocytes under the shear stress environment of clinorotation have demonstrated an inhibition of activation in response to TCR mediated signaling. These results mimic those observed during space flight. This work investigates the molecular signaling events of T lymphocyte activation with clinorotation. Purified human T lymphocytes and the T cell clone Jurkat exhibit an uncoupling of signaling as mediated through the TCR. Activation of the transcription factor AP-1 is inhibited while activation of NFAT occurs. NFAT dephosphorylation and activation is dependent on sustained Ca(++) influx. Alternatively, AP-1, which consists of two transcription factors, jun and fos, is activated by PKC and Ras mediated pathways. TCR signaling is known to be dependent on cytoskeletal rearrangements, in particular, raft aggregation is critical. Raft aggregation, as mediated through GM, crosslinking, overcomes the inhibition of T lymphocyte activation with clinorotation, indicating that the block is occurring upstream of raft aggregation. Clinorotation is shown to have an effect similar to a weak TCR signal.
Author
Microgravity; Gravitational Effects; Clinorotation; Lymphocytes; Transcription (Genetics)

20030067925 NASA Marshall Space Flight Center, Huntsville, AL, USA
Structure-Derived Proton-Transfer Mechanism of Action Human Pyruvate Dehydrogenase
Ciszak, Ewa; Dominiak, Paulina; [2003]; 1 pp.; In English; No Copyright; Avail: Other Sources; Abstract Only

The derivative of vitamin B1 thiamin pyrophosphate (TPP) is a cofactor of pyruvate dehydrogenase (E1p) that is involved in decarboxylation of pyruvate followed by reductive acetylation of lipoic acid covalently bound to a lysine residue of dihydrolipoamide acetyltransferase. The structure of E1p recently determined in our laboratory revealed patterns of association of foul subunits and specifics of two TPP binding sites. The mechanism of action in part includes a conserved hydrogen bond between the N1' atom of the aminopyrimidine ring of the cofactor and the carboxylate group of Glu59 from the beta subunits, and a V-conformation of the cofactor that brings the N4' atom of the aminopyrimidine ring to the distance of the intramolecular hydrogen bond formed with the C2-atom of the thiazolium moiety. The carboxylate group of Glu59 is the local proton acceptor that enables proton translocation within the aminopyrimidine ring and stabilization of the rare N4' - iminopyrimidine tautomer. Based on the analysis of E1p structure, we postulate that the protein environment drives N4' - amino/N4' - imino dynamics resulting in a concerted shuttle-like movement of the subunits. We also propose that this movement of the subunits is strictly coordinated with the two enzymatic reactions carried out in E1p by each of the two cofactor sites. It is proposed that these reactions are in alternating phases such that when one active site is involved in decarboxylation, the other is involved in acetylation of lipoyl noiety.
Author
Protons; Biology; Tautomers; Pyruvates; Lipoic Acid

20030067939 Salk Inst. for Biological Studies, San Diego, CA, USA
Hydrolysis of tRNA(sup Phe) on Suspensions of Amino Acids
Gao, Kui; Orgel, Leslie E.; Helvetica Chimica Acta; 2001; Volume 84, pp. 1347-1354; In English
Contract(s)/Grant(s): NAG5-4546; NAGW-1660; NAGW-2881; Copyright; Avail: Other Sources

RNA is adsorbed strongly on suspensions of many moderately soluble organic solids. In some cases, the hydrolysis of tRNA(sup Phe) is greatly accelerated by adsorption, and the major sites of hydrolysis are changed from those that are important in homogeneous solution. Here we show that the hydrolysis is greatly accelerated by suspensions of aspartic acid and beta-glutamic acid but not by suspensions of alpha-glutamic acid, asparagine, or glutamine. The non-enzymatic hydrolysis of RNA has been studied extensively, especially because of its relevance to the mechanisms of action of ribozymes and to

biotechnology and therapy. Many ribonucleases, ribozymes, and non-biological catalysts function via acid-base catalysis of an intramolecular transesterification mechanism in which the 2'-OH group attacks the adjacent phosphate group. The pentacoordinated phosphorane intermediate may collapse back to starting material, or yield isomerized or cleaved products. Derived from text

Hydrolysis; Ribonucleic Acids; Amino Acids

20030067940 Scripps Research Inst., La Jolla, CA, USA

Catalytic Activity of a Binary Informational Macromolecule

Reader, John S.; Joyce, Gerald F.; [2003]; 16 pp.; In English

Contract(s)/Grant(s): NAG5-4546; Copyright; Avail: Other Sources

RNA molecules are thought to have played a prominent role in the early history of life on Earth based on their ability both to encode genetic information and to exhibit catalytic function. The modern genetic alphabet relies on two sets of complementary base pairs to store genetic information. However, due to the chemical instability of cytosine, which readily deaminates to uracil, a primitive genetic system composed of the bases A, U, G and C may have been difficult to establish. It has been suggested that the first genetic material instead contained only a single base-pairing unie'. Here we show that binary informational macromolecules, containing only two different nucleotide subunits, can act as catalysts. In vitro evolution was used to obtain ligase ribozymes composed of only 2,6-diaminopurine and uracil nucleotides, which catalyze the template-directed joining of two RNA molecules, one bearing a 5'-triphosphate and the other a 3'-hydroxyl. The active conformation of the fastest isolated ribozyme had a catalytic rate that was about 36,000-fold faster than the uncatalyzed rate of reaction. This ribozyme is specific for the formation of biologically relevant 3',5'-phosphodiester linkages.

Author

Catalytic Activity; Genetic Code; Macromolecules; Ribonucleic Acids; Nucleotides

20030067986 Scripps Research Inst., La Jolla, CA, USA

RNA-Cleaving DNA Enzymes with Altered Regio- or Enantioselectivity

Ordoukhanian, Phillip; Joyce, Gerald F.; September 17, 2002; 8 pp.; In English

Contract(s)/Grant(s): NAG5-4546; SFP-1076; Copyright; Avail: Other Sources

In vitro evolution methods were used to obtain DNA enzymes that cleave either a 2',5' - phosphodiester following a wibonucleotide or a 3',5' -phosphodiester following an L-ribonucleotide. Both enzymes can operate in an intermolecular reaction format with multiple turnover. The DNA enzyme that cleaves a 2',5' -phosphodiester exhibits a k(sub cat) of approx. 0.01/ min and catalytic efficiency, k(sub cat)/k(sub m) of approx. 10(exp 5)/ M min. The enzyme that cleaves an L-ribonudeotide is about 10-fold slower and has a catalytic efficiency of approx. 4 x 10(exp 5)/ M min. Both enzymes require a divalent metal cation for their activity and have optimal catalytic rate at pH 7-8 and 35-50 C. In a comparison of each enzyme s activity with either its corresponding substrate that contains an unnatural ribonudeotide or a substrate that instead contains a standard ribonucleotide, the 2',5' -phosphodiester-deaving DNA enzyme exhibited a regioselectivity of 6000- fold, while the L-ribonucleotide-cleaving DNA enzyme exhibited an enantioselectivity of 50-fold. These molecules demonstrate how in vitro evolution can be used to obtain regio- and enantioselective catalysts that exhibit specificities for nonnatural analogues of biological compounds.

Author

Ribonucleic Acids; Deoxyribonucleic Acid; Enzyme Activity; Catalysts

20030067991 Scripps Institution of Oceanography, La Jolla, CA, USA

Life Out of Chaos

Arrhenius, Gustaf; Fundamentals of Life; 2002; 9 pp.; In English

Contract(s)/Grant(s): NAG5-4546; NAG5-4563; NAGW-1031; Copyright; Avail: Other Sources

Doctinary overlays on the definition of life can effectively be avoided by focusing discussion on microorganisms, their vital processes, and their genetic pedigree. To reach beyond these present and highly advanced forms of life and to inquire about its origin it is necessary to consider the requirements imposed by the environment. These requirements include geophysically and geochemically acceptable conjectures for the generation of source compounds, their concentration from dilute solution, and their selective combination into functional biomolecules. For vital function these macromolecules require programming in the form of specific sequence motifs. This critical programming constitutes the scientifically least understood

process in the origin of life. Once this stage has been surpassed the laws of Darwinian evolution can operate in ways that are understood and experimentally demonstrated.
Author
Biological Evolution; Biochemistry

20030068002 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Microbial Genomes Multiply
Doolittle, Russell F.; Nature; 18 Apr. 2002; Volume 416, pp. 697-700; In English
Contract(s)/Grant(s): NAG5-4546; Copyright; Avail: Other Sources

The publication of the first complete sequence of a bacterial genome in 1995 was a signal event, underscored by the fact that the article has been cited more than 2,100 times during the intervening seven years. It was a marvelous technical achievement, made possible by automatic DNA-sequencing machines. The feat is the more impressive in that complete genome sequencing has now been adopted in many different laboratories around the world. Four years ago in these columns I examined the situation after a dozen microbial genomes had been completed. Now, with upwards of 60 microbial genome sequences determined and twice that many in progress, it seems reasonable to assess just what is being learned. Are new concepts emerging about how cells work? Have there been practical benefits in the fields of medicine and agriculture? Is it feasible to determine the genomic sequence of every bacterial species on Earth? The answers to these questions maybe Yes, Perhaps, and No, respectively.
Author
Bacteria; Genome; Sequencing

20030068005 NASA Marshall Space Flight Center, Huntsville, AL, USA
Which Strategy for a Protein Crystallization Project?
Kundrot, Craig E.; [2003]; 1 pp.; In English; No Copyright; Avail: Other Sources; Abstract Only

The three-dimensional, atomic-resolution protein structures produced by X-ray crystallography over the past 50+ years have led to tremendous chemical understanding of fundamental biochemical processes. The pace of discovery in protein crystallography has increased greatly with advances in molecular biology, crystallization techniques, cryo-crystallography, area detectors, synchrotrons and computing. While the methods used to produce single, well-ordered crystals have also evolved over the years in response to increased understanding and advancing technology, crystallization strategies continue to be rooted in trial-and-error approaches. This review summarizes the current approaches in protein crystallization and surveys the first results to emerge from the structural genomics efforts.
Author
Protein Crystal Growth; Single Crystals; Three Dimensional Models; Atomic Structure

20030068006 Scripps Research Inst., La Jolla, CA, USA
Substitution of Ribonucleotides in the T7 RNA Polymerase Promoter Element
McGinness, Kathleen E.; Joyce, Gerald F.; 9 Nov. 2001; 19 pp.; In English
Contract(s)/Grant(s): NAG5-9386; Copyright; Avail: CASI; A03, Hardcopy

A systematic analysis was carried out to examine the effects of ribonucleotide substitution at various locations within the promoter element for T7 RNA polymerase. Ribonucleotides could be introduced at most positions without significantly decreasing transcription efficiency. A critical window of residues that were intolerant of RNA substitution was defined for both the non-template and template strands of the promoter. These residues are involved in important contacts with the AT-rich recognition loop, specificity loop, and P-intercalating hairpin of the polymerase. These results highlight the malleability of T7 RNA polymerase in recognizing its promoter element and suggest that promoters with altered backbone conformations may be used in molecular biology applications that employ T7 RNA polymerase for in vitro transcription.
Author
Ribonucleic Acids; Transcription (Genetics); Enzymes

20030068036 Salk Inst. for Biological Studies, La Jolla, CA, USA
A Simpler Nucleic Acid
Orgel, Leslie; Science; [2000]; Volume 290, pp. 1306-1307; In English
Contract(s)/Grant(s): NAG5-4546; Copyright; Avail: Other Sources

It has been supposed that for a nucleic acid analog to pair with RNA it must, like RNA, have a backbone with at least

a sixatom repeat; a shorter backbone presumably would not stretch far enough to bind RNA properly. The Eschenmoser group has shown, however, that this first impression is incorrect.As they report in their new paper, Eschenmoser and co-workers (I) have now synthesized a substantial number of these polymers, which are called (L)-a-threofuranosyl oligonucleotides or TNAs. They are composed of bases linked to a threose sugar-phosphate backbone, with phosphodiester bonds connecting the nucleotides. The investigators discovered that pairs of complementary TNAs do indeed form stable Watson-Crick double helices and, perhaps more importantly, that TNAs form stable double helices with complementary RNAs and DNAs.
Author
Ribonucleic Acids; Evolution (Development)

20030068039 Salk Inst. for Biological Studies, San Diego, CA, USA
Remote Enantioselection Transmitted by an Achiral Peptide Nucleic Acid Backbone
Kozlov, Igor A.; Orgel, Leslie E.; Nielsen, Peter E.; Angewandte Chemie-International Edition; [2000]; ISSN 1433-7851; Volume 39, No. 23, pp. 3923-4293; In English
Contract(s)/Grant(s): NAG5-4118; NAG5-4546; Copyright; Avail: Other Sources

short homochiral segment of DNA into a PNA helix could have guaranteed that the next short segment of DNA to be incorporated would have the same handedness as the first. Once two segments of the same handedness were present, the probability that a third segment would have the same handedness would increase, and so on. Evolution could then slowly dilute out the PNA part. This scenario would ultimately allow the formation of a chiral oligonucleotide by processes that are largely resistant to enantiomeric crossinhibition. It is important to note that the ligation of homochiral dinucleotides on a nucleic acid template would probably be at least as enantiospecific as the reaction that we have studied. The disadvantage of using chiral monomers as components of a replicating system arises from the difficulty of generating a first long homochiral template from a racemic mixture of monomers, although results of experiments designed to overcome this difficulty by employing homochiral tetramers have been reported.l l The probability of obtaining a homochiral n-mer from achiral substrates is approximately 1P-I if the nontemplate-directed extension of the primer is not enantioselective. Hence, it would be very hard to get started with a homochiral 40-mer, for example. No such difficulty exists in a scenario that originates with an achiral genetic material and in which the incorporation of very few chiral monomers in this achiral background gradually progresses towards homochirality. It seems possible that some PNA sequences could act as catalysts, analogous to ribozymes, even though PNA lacks clear metal binding sites. Although such catalysts could not be enantioselective, the incorporation of as few as two chiral nucleotides could then impose chiral specificity on the system. Furthermore, such patch chimeras could help to bridge the gap in catalytic potential between PNA and RNA, while guaranteeing enantioselectivity.
Author
Deoxyribonucleic Acid; Ribonucleic Acids; Templates

20030068044 Scripps Institution of Oceanography, San Diego, CA, USA
Radiation-Dependent Limit for the Viability of Bacterial Spores in Halite Fluid Inclusions and on Mars
Kminek, Gerhard; Bada, Jeffrey L.; Pogliano, Kit; Ward, John F.; Radiation Research; [2003]; ISSN 0033-7587; Volume 159, pp. 722-729; In English
Contract(s)/Grant(s): NAG5-4546; Copyright; Avail: Other Sources

When claims for the long-term survival of viable organisms are made, either within terrestrial minerals or on Mars, considerations should be made of the limitations imposed by the naturally occurring radiation dose to which they have been exposed. We investigated the effect of ionizing radiation on different bacterial spores by measuring the inactivation constants for B. subtilis and s. marismortui spores in solution as well as for dry spores of B. subtilis and B. thuringiensis. S. marismortui is a halophilic spore that is genetically similar to the recently discovered 2-9-3 bacterium from a halite fluid inclusion, claimed to be 250 million years old, B. thuringiensis is a soil bacterium that is genetically similar to the human pathogens B. anthracis and B. cereus. To relate the inactivation constant to some realistic environments, we calculated the radiation regimen in a halite fluid inclusion and in the Martian subsurface over time. Our conclusion is that the ionizing dose of radiation in those environments limits the survival of viable bacterial spores over long periods. In the absence of an active repair mechanism in the dormant state, the long-term survival of spores is limited to less than 109 million years in halite fluid inclusions, to 100 to 160 million years in the Martian subsurface below 3 m, and to less than 600,000 years in the upper-most meter of Mars.
Author
Bacteria; Spores; Survival; Organisms; Ionizing Radiation; Hibernation; Bacillus

20030068045 Scripps Institution of Oceanography, La Jolla, CA, USA

Prebiotic Soup-Revisiting the Miller Experiment

Bada, Jeffrey L.; Lazcano, Antonio; Science; [2003]; Volume 300, pp. 745-746; In English

Contract(s)/Grant(s): NAG5-4546; Copyright; Avail: Other Sources

'Isn't life wonderful?' sang Alma Cogan and Les Howard in their almost forgotten 1953 hit. That same year, Stanley L. Miller raised the hopes of understanding the origin of life when on 15 May, Science published his paper on the synthesis of amino acids under conditions that simulated primitive Earth's atmosphere. Miller had applied an electric discharge to a mixture of CH4, NH3, H2O, and H2 - believed at the time to be the atmospheric composition of early Earth. Surprisingly, the products were not a random mixture of organic molecules, but rather a relatively small number of biochemically significant compounds such as amino acids, hydroxy acids, and urea. With the publication of these dramatic results, the modem era in the study of the origin of life began.

Author

Biological Evolution; Experimentation; Environment Simulation

20030068146 California Univ., La Jolla, CA, USA

The Nicotinamide Biosynthetic Pathway Is a By-product of the RNA World

Cleaves, H. James; Miller, Stanley L.; Journal of Molecular Evolution; [2003]; Volume 52, pp. 73-77; In English

Contract(s)/Grant(s): NAG5-4546; Copyright; Avail: Other Sources

Many of the biosynthetic pathways, especially those leading to the coenzymes, must have originated very early, perhaps before enzymes were available to catalyze their synthesis. While a number of enzymatic reactions in metabolism are known to proceed nonenzymatically, there are no examples of entire metabolic sequences that can be achieved in this manner. The most primitive pathway for nicotinic acid biosynthesis is the reaction of aspartic acid with dihydroxyacetone phosphate. We report here that nicotinic acid (NAc) and its metabolic precursor, quinolinic acid (QA), are produced in yields as high as 7% in a six-step nonenzymatic sequence from aspartic acid and dihydroxyacetone phosphate (DHAP). The biosynthesis of ribose phosphate could have produced DHAP and other three carbon compounds. Aspartic acid could have been available from prebiotic synthesis or from the ribozyme synthesis of pyrimidines. These results suggest that NAD could have originated in the RNA world and that the nonenzymatic biosynthesis of the cofactor nicotinamide could have been an inevitable consequence of life based on carbohydrates and amino acids. The enzymes of the modern pathway were later added in any order.

Author

Nicotinamide; Biosynthesis; Coenzymes; Ribonucleic Acids

20030068148 California Univ., San Diego, La Jolla, CA, USA

Some Like It Hot, But Not the First Biomolecules

Bada, Jeffrey L.; Lazcano, Antonio; Science Reprint; 14 Jun. 2002; Volume 296, pp. 1982-1983; In English

Contract(s)/Grant(s): NAG5-4546; Copyright; Avail: Other Sources

Ever since the pioneering work of Aleksandr Oparin and John Haldane nearly a century ago, the prebiotic soup theory has dominated thinking about how life emerged on Earth. According to the modern version of this theory, organic compounds accumulated in the primordial oceans and underwent polymerization, producing increasingly complex macromolecules that eventually evolved the ability to catalyze their own replication (see the figure). But is this really how life originated? And what were the conditions that favored its emergence?

Author

Biochemistry; Biological Evolution; Organic Compounds; Temperature Effects

20030068166 NASA Marshall Space Flight Center, Huntsville, AL, USA

Through Microgravity and Towards the Stars: Microgravity and Strategic Research at Marshall's Biological and Physical Space Research Laboratory

Curreri, Peter A.; [2003]; 1 pp.; In English; Gordon Research Conferences, 26 Jul. - 1 Aug. 2003, New London, CT, USA; No Copyright; Avail: Other Sources; Abstract Only

The Microgravity and Strategic research at Marshall s Biological and Physical Space Research Laboratory will be reviewed. The environment in orbit provides a unique opportunity to study Materials Science and Biotechnology in the absence of sedimentation and convection. There are a number of peer-selected investigations that have been selected to fly on the Space Station that have been conceived and are led by Marshall s Biological and Physical Research Laboratory s scientists.

In addition to Microgravity research the Station will enable research in 'Strategic' Research Areas that focus on enabling humans to live, work, and explore the solar system safely. New research in Radiation Protection, Strategic Molecular Biology, and In-Space Fabrication will be introduced.
Author
Biotechnology; Sediments; Radiation Protection; Molecular Biology; Microgravity

20030068186 California Univ., San Diego, La Jolla, CA, USA
How We Defend Ourselves Against Infectious Diseases
Wills, Christopher; ASM News; [2000]; Volume 66, No. 9, pp. 523-530; In English; Original contains color illustrations; Copyright; Avail: Other Sources

I have spent years investigating how we have survived as a species in spite of the fact that we are prey to a terrifying assortment of bacterial, viral, fungal and animal pathogens. This struggle between us and our pathogens is conducted in subtle and complex ways, and a similar struggle is also going on between millions of other host animals and plants and their respective pathogens throughout the living world. To understand these processes, it is necessary to look at the selective forces acting on our own species and also to ask more sweeping questions: what is the true evolutionary role of disease in the natural world? Are diseases, in spite of the suffering and misery they cause, entirely a negative influence? Our principal defense against infectious diseases is the immune system. This system, next to our brains, is the most complex product of evolution that we know. It protects us against wide variety of pathogens. A prescient cartoon from the 1820s- drawn decades before Pasteur developed his germ theory of disease and well before John Snow stopped an outbreak of typhoid fever in London by removing the handle of the public water pump in Broad Street depicts creatures that supposedly inhabited the filthy waters of the River Thames. Although a fantasy, the cartoon vividly anticipates those subsequent scientific discoveries as well as the simple fact that many varied, living pathogenic organisms cause diseases.
Author
Infectious Diseases; Pathogens; Populations; Immune Systems

20030068190 NASA Johnson Space Center, Houston, TX, USA
The Neurolab Spacelab Mission: Neuroscience Research in Space: Results from the STS-90, Neurolab Spacelab Mission
Buckey, Jay C., Jr., Editor; Homick, Jerry L., Editor; January 2003; 308 pp.; In English; See also 20030068191 - 20030068228; Original contains color illustrations
Report No.(s): NASA/SP-2003-535; S-870; NAS 1.21:535; LC-2003000685; No Copyright; Avail: CASI; A14, Hardcopy

Neurolab (STS-90) represents a major scientific achievement that built upon the knowledge and capabilities developed during the preceding 15 successful Spacelab module missions. NASA proposed a dedicated neuroscience research flight in response to a Presidential declaration that the 1990's be the Decade of the Brain. Criteria were established for selecting research proposals in partnership with the National Institutes of Health (NM), the National Science Foundation, the Department of Defense, and a number of the International Space Agencies. The resulting Announcement of Opportunity for Neurolab in 1993 resulted in 172 proposals from scientists worldwide. After an NIH-managed peer review, NASA ultimately selected 26 proposals for flight on the Neurolab mission.
Derived from text
Space Transportation System; Neurology; Spacelab; Manned Space Flight; Physiological Effects; Weightlessness

20030068192 NASA Johnson Space Center, Houston, TX, USA
Animal Care on Neurolab
Buckey, Jay C., Jr.; Linnehan, Richard M.; Dunlap, Alexander W.; The Neurolab Spacelab Mission: Neuroscience Research in Space: Results from the STS-90, Neurolab Spacelab Mission; January 2003, pp. 295-298; In English; See also 20030068190; Original contains black and white illustrations; No Copyright; Avail: CASI; A01, Hardcopy

The Neurolab mission carried rats, mice, snails, crickets, and two kinds of fish into space. This was the largest variety of living things ever flown on a space mission. On the whole, the experimental animals were healthy during the flight, but there was a notable exception. Although all the mice, adult rats, and most of the young (14 days old at launch) rats did well, more than half of the youngest rats, eight days old at launch, died in the Research Animal Holding Facility inflight. Several factors contributed to this, including housing design and inadequate monitoring capability. An understanding of why this occurred is important for the planning of future space missions.
Author
Rats; Space Missions; Mice; Physiological Responses

20030068194 Dartmouth Medical School, Hanover, NH, USA

Biotelemetry for Studying Circadian Rhythms

Buckey, Jay C., Jr.; Fuller, Patrick M.; Murakami, Dean M.; Hoban-Higgins, Tana M.; The Neurolab Spacelab Mission: Neuroscience Research in Space: Results from the STS-90, Neurolab Spacelab Mission; January 2003, pp. 263-265; In English; See also 20030068190; Original contains black and white illustrations; No Copyright; Avail: CASI; A01, Hardcopy

Body temperature and heart rate change in synchrony with the 24-hour day. Several other physiologic parameters, including hormones and activity, also show daily rhythms. The day-to-day rhythms of these changes are called circadian rhythms. Circadian rhythms are altered by weightlessness; however, studying the nature of these changes in space requires robust, reliable, and small instrumentation. Continuous heart rate and body temperature measurements are particularly important, but a system requiring external electrodes and connecting wires would not be practical in space. One solution to this problem is to use biotelemetry. With biotelemetry, small sensors are placed within the body and the information is transmitted outside the body by radio waves. In this way, measurements can be made continuously, without restraining wires or external electrodes. A biotelemetry system was developed for use with the adult rats on Neurolab. With this system, continuous heart rate and body temperature data were collected during flight. This system demonstrated how physiologic data could be collected easily with minimal crew involvement.

Author

Circadian Rhythms; Biotelemetry

20030068195 NASA Johnson Space Center, Houston, TX, USA

Crew Perspectives From Neurolab

The Neurolab Spacelab Mission: Neuroscience Research in Space: Results from the STS-90, Neurolab Spacelab Mission; January 2003, pp. 291-293; In English; See also 20030068190; Original contains black and white illustrations; No Copyright; Avail: CASI; A01, Hardcopy

Neurolab had a crew of nine, seven flight crew in orbit and two alternate payload specialists who served in the payload operations and control center during the flight. All the crewmembers were involved in shaping a complex scientific payload into a set of workable procedures that could be done in space. This process gave them a unique perspective on the mission as a whole.

Author

Spacecrews; Research Projects; Animals

20030068216 Fukushima Medical Univ., Fukushima, Japan

Development of the Aortic Baroreflex in Microgravity

Shimizu, Tsuyoshi; Yamasaki, Masao; Waki, Hidefumi; Katsuda, Shin-ichiro; Oishi, Hirotaka; Katahira, Kiyoaki; Nagayama, Tadanori; Miyake, Masao; Miyamoto, Yukako, et al.; The Neurolab Spacelab Mission: Neuroscience Research in Space: Results from the STS-90, Neurolab Spacelab Mission; January 2003, pp. 151-159; In English; See also 20030068190; Original contains black and white illustrations

Contract(s)/Grant(s): MOE-08407004; No Copyright; Avail: CASI; A02, Hardcopy

Baroreceptors sense pressure in blood vessels and send this information to the brain. The primary baroreceptors are located in the main blood vessel leaving the heart (the aorta) and in the arteries in the neck (the carotid arteries). The brain uses information from the baroreceptors to determine whether blood pressure should be raised or lowered. These reflex responses are called baroreflexes. Changing position within a gravity field (i.e., moving from lying to sitting or standing) powerfully stimulates the baroreflexes. In weightlessness, the amount of stimuli that the baroreflexes receive is dramatically reduced. If this reduction occurs when the pathways that control the baroreflexes are being formed, it is possible that either the structure or function of the baroreceptors may be permanently changed. To study the effect of microgravity on structural and functional development of the aortic baroreflex system, we studied young rats (eight days old at launch) that flew on the Space Shuttle Columbia for 16 days. Six rats were studied on landing day; another six were studied after re-adapting to Earth's gravity for 30 days. On both landing day and 30 days after landing, we tested the sensitivity of the rats' baroreflex response. While the rats were anaesthetized, we recorded their arterial pressure, heart rate, and aortic nerve activity. After the tissues were preserved with perfusion fixation, we also examined the baroreflex structures. On landing day, we found that, compared to the controls, the flight rats had: fewer unmyelinated nerve fibers in their aortic nerves lower baroreflex sensitivity significantly lower contraction ability and wall tension of the aorta a reduced number of smooth muscle cells in the aorta. In the 30-day recovery group, the sensitivity of the baroreflex showed no difference between the flight rats and the control groups, although the unmyelinated fibers of the aortic nerve remained reduced in the flight rats. The results show that spaceflight does affect the development of the aortic baroreflex. The sensitivity of the reflex may be suppressed; however, the function of the

blood pressure control system can re-adapt to Earth's gravity if the rats return before maturation. The structural differences in the input pathway of the reflex (Le., the reduction in nerve fibers) may remain permanently.
Author
Gravitational Effects; Space Flight; Microgravity; Baroreflexes

20030068246 California Univ., San Diego, CA, USA
Bacterial Actins? An Evolutionary Perspective
Doolittle, Russell F.; York, Amanda L.; [2003]; 4 pp.; In English
Contract(s)/Grant(s): NAG5-4546; Copyright; Avail: Other Sources

According to the conventional wisdom, the existence of a cytoskeleton in eukaryotes and its absence in prokaryotes constitute a fundamental divide between the two domains of life. An integral part of the dogma is that a cytoskeleton enabled an early eukaryote to feed upon prokaryotes, a consequence of which was the occasional endosymbiosis and the eventual evolution of organelles. Two recent papers present compelling evidence that actin, one of the principal components of a cytoskeleton, has a homolog in Bacteria that behaves in many ways like eukaryotic actin. Sequence comparisons reveml that eukaryotic actin and the bacterial homolog (mreB protein), unlike many other proteins common to eukaryotes and Bacteria, have very different and more highly extended evolutionary histories.
Author
Bacteria; Eukaryotes; Proteins

20030068248 California Univ., San Diego, La Jolla, CA, USA
The Microsatellites of Escherichia Coli: Rapidly Evolving Repetitive DNAs in a Non-Pathogenic Prokaryote
Metzgar, David; Thomas, Elizabeth; Davis, Clara; Field, Dawn; Wills, Christopher; Molecular Microbiology; [2001]; Volume 39, No. 1, pp. 183-190; In English; Original contains black and white illustrations
Contract(s)/Grant(s): NAG5-4546; Copyright; Avail: Other Sources

We have demonstrated hypervariablilty of native short-motif repeats (microsatellites) In Escherichia coli. Twenty-five of the longest microsatellites in the E. coli genome were identified. These were analysed for length variability among 22 wild-type (non-mutator) isolates from the E. coli collection of reference (ECOR). Nontodlng mononucleotide repeats are consistently polymorphic among these genetically diverse E. coli. Length differences In variable mlcrosatellites allowed all E. coli strains examined to be uniquely differentiated. Phylogenetic analysis of the variable repeats shows ubiquitous homoplasy at the level of divergence represented by the sample set, suggesting that these markers are hypermutable and should prove valuable for the discrimination of closely related strains that are not otherwise genetically differentiable. Genomic analyses suggest that similar markers are also likely to be found in all other prokaryotes.
Author
Escherichia; Microsatellites; Prokaryotes; Deoxyribonucleic Acid; Microbiology

20030068281 California Univ., San Diego, La Jolla, CA, USA
Concentration by Evaporation and the Prebiotic Synthesis of Cytosine
Nelson, Kevin E.; Robertson, Michael P.; Levy, Matthew; Miller, Stanley L.; Origins of Life and Evolution of the Biosphere; 2001; Volume 31, pp. 221-229; In English
Contract(s)/Grant(s): NAG5-4546; Copyright; Avail: Other Sources

The efficient prebiotic synthesis of cytosine from urea and cyanoacetaldehyde (CA) has recently been claimed to be invalid on the basis of possible side reactions of the starting materials and the inapplicability of prebiotic syntheses using drying beach conditions. We therefore have investigated the synthesis of cytosine and uracil from urea and cyanoacetaldehyde at 100 C under dry-down conditions, and in solution at 4 C and -20 C. We find that cytosine is produced from the low temperature experiments more efficiently than calculated from the Arrhenius extrapolation from higher temperatures, i.e., 60-120 C. In addition, we find that CA dimer is as efficient as the monomer in cytosine synthesis. We also studied whether evaporating very dilute solutions of nonvolatile organic compounds will concentrate according to theory. Solutions as dilute as 10(exp -4) M concentrate from pure water approximately according to theory. Similar solutions in 0.5 M NaCl have less than theoretical concentrations due to absorption, but concentrations near dryness were very high.
Author
Evaporation; Synthesis (Chemistry); Uracil; Ureas; Acetyl Compounds

20030068313 Colorado Univ., Boulder, CO, USA, NASA Ames Research Center, Moffett Field, CA, USA
The Application of Advanced Cultivation Techniques in the Long Term Maintenance of Space Flight Plant Biological Systems
Heyenga, A. G.; August 10, 2003; 3 pp.; In English
Contract(s)/Grant(s): NCC2-1145; UOC Proj. 1531994; No Copyright; Avail: CASI; A01, Hardcopy

The development of the International Space Station (ISS) presents extensive opportunities for the implementation of long duration space life sciences studies. Continued attention has been placed in the development of plant growth chamber facilities capable of supporting the cultivation of plants in space flight microgravity conditions. The success of these facilities is largely dependent on their capacity to support the various growth requirements of test plant species. The cultivation requirements for higher plant species are generally complex, requiring specific levels of illumination, temperature, humidity, water, nutrients, and gas composition in order to achieve normal physiological growth and development. The supply of water, nutrients, and oxygen to the plant root system is a factor, which has proven to be particularly challenging in a microgravity space flight environment. The resolution of this issue is particularly important for the more intensive crop cultivation of plants envisaged in Nasa's advanced life support initiative. BioServe Space Technologies is a NASA, Research Partnership Center (RPC) at the University of Colorado, Boulder. BioServe has designed and operated various space flight plant habitat systems, and placed specific emphasis on the development and enhanced performance of subsystem components such as water and nutrient delivery, illumination, gas exchange and atmosphere control, temperature and humidity control. The further development and application of these subsystems to next generation habitats is of significant benefit and contribution towards the development of both the Space Plant biology and the Advanced Life Support Programs. The cooperative agreement between NASA Ames Research center and BioServe was established to support the further implementation of advanced cultivation techniques and protocols to plant habitat systems being coordinated at NASA Ames Research Center. Emphasis was placed on the implementation of passive-based water and nutrient support systems and techniques, which can be used to minimize demands on power, mass, and operational complexity in space flight studies. This effort has direct application to the development of next-generation space flight plant chambers such as the Plant Research Unit (PRU). Work was also directed at the development of in-flight plant preservation techniques and protocols consistent with the interest in applying recent developments in gene chip micro array technologies. Cultivation technologies and protocols were evaluated in a 55 day space flight plant growth study, conducted on the ISS, mission 9A (10/7/02 - 12/7/02).
Derived from text
Cultivation; Space Flight; Plants (Botany); International Space Station; Life Sciences

20030068425 California Univ., San Diego, La Jolla, CA, USA
The Occurrence of Type S1A Serine Proteases in Sponge and Jellyfish
Rojas, Ana; Doolittle, Russell F.; [2003]; 12 pp.; In English
Contract(s)/Grant(s): NAG5-4546; No Copyright; Avail: CASI; A03, Hardcopy

Although serine proteases are found in all kinds of cellular organisms and many viruses, the classic 'chymotrypsin family' (Group S1A by the 1998 Barrett nomenclature) has an unusual phylogenetic distribution, being especially common in animals, entirely absent from plants and protists, and rare among fungi. The distribution in Bacteria is largely restricted to the genus Streptomyces, although a few isolated occurrences in other bacteria have been reported. The family may be entirely absent from Archaea. Although more than a thousand sequences have been reported for enzymes of this type from animals, none of them have been from early diverging phyla like Porifera or Cnidaria, We now report the existence of Group SlA serine proteases in a sponge (phylum Porifera) and a jellyfish (phylum Cnidaria), making it safe to conclude that all animal groups possess these enzymes.
Author
Bacteria; Enzymes; Protease; Sponges (Materials); Fishes

20030068444 California Univ., San Diego, La Jolla, CA, USA
Gene Transfers Between Distantly Related Organisms
Doolittle, Russell F.; Horizontal Gene Transfer; [2003], pp. 269-275; In English
Contract(s)/Grant(s): NAG5-4546; Copyright; Avail: Other Sources

With the completion of numerous microbial genome sequences, reports of individual gene transfers between distantly related prokaryotes have become commonplace. On the other hand, transfers between prokaryotes and eukaryotes still excite the imagination. Many of these claims may be premature, but some are certainly valid. In this chapter, the kinds of supporting

data needed to propose transfers between distantly related organisms and cite some interesting examples are considered.
Author
Genome; Prokaryotes; Microorganisms; Organisms; Genes

20030068473 California Univ., San Diego, La Jolla, CA, USA
The Grand Assault
Doolittle, Russell F.; Meyer, Michael, Technical Monitor; Nature News and Views: Special Malaria Issue; [2003]; 8 pp.; In English
Contract(s)/Grant(s): NAG5-4546; Copyright; Avail: Other Sources

Plasmodium falciparum, the protozoan parasite responsible for most human malaria, is among the most studied pathogens of all time, probably only exceeded by the human immunodeficiency virus HTV and the bacterium Mycobacterium tuberculosis. The extent of human suffering and the devastating costs of malaria have long been recognized by world bodies, and numerous initiatives have been taken over the years in an effort to defeat this insidious microbe. Beginning in 1996, an international consortium of scientists from more than a dozen institutions set about to determine the sequence of the organism's 23-megabase genome. Their massive effort-which ended up going well beyond simple sequencing is reported in this special issue of Nature. The avowed goal of the project was to search for chinks in the parasite's armor so that new and effective drugs and vaccines might be developed.
Author
Human Immunodeficiency Virus; Immune Systems; Microorganisms; Parasitic Diseases

20030068491 NASA Ames Research Center, Moffett Field, CA, USA
The Roads to and from the RNA World
Dworkin, Jason P.; Lazcano, Antonio; Miller, Stanley L.; [2003]; 20 pp.; In English
Contract(s)/Grant(s): NAG5-4546; Proj. PAPIIT-IN2135; Copyright; Avail: Other Sources

The historical existence of the RNA world, in which early life used RNA for both genetic information and catalytic ability, is widely accepted. However, there has been little discussion of whether protein synthesis arose before DNA or what preceded the RNA world (i.e. the pre-RNA world). We outline arguments of what route life may have taken out of the RNA world: whether DNA or protein followed. The metabolic arguments favor the possibility that RNA genomes preceded the use of DNA as the informational macromolecule. However, the opposite can also be argued based on the enhanced stability, reactivity, and solubility of 2-deoxyribose as compared to ribose. The possibility that DNA may have come before RNA is discussed, although it is a less parsimonious explanation than DNA following RNA.
Author
Ribonucleic Acids; Protein Synthesis; Biological Evolution; Deoxyribonucleic Acid

20030068510 California Univ., San Diego, La Jolla, CA, USA
Fatal Saccharomyces Cerevisiae Aortic Graft Infection
Meyer, Michael, Technical Monitor; Smith, Davey; Metzgar, David; Wills, Christopher; Fierer, Joshua; Journal of Clinical Microbiology; [2002]; ISSN 0095-1137; Volume 40, No. 7, pp. 2691-2692; In English; Original contains color illustrations
Contract(s)/Grant(s): NAG5-4546; Copyright; Avail: Other Sources

Saccharomyces cerevisiae is a yeast commonly used in baking and a frequent colonizer of human mucosal surfaces. It is considered relatively nonpathogenic in immunocompetent adults. We present a case of S. cerevisiae fungemia and aortic graft infection in an immunocompetent adult. This is the first reported case of S. cerevisiue fungemia where the identity of the pathogen was confirmed by rRNA sequencing.
Author
Infectious Diseases; Pathogens; Saccharomyces

20030068689 EMPA, Dubendorf, Switzerland
An Overview of DLC Coatings for Biological Applications
Hauert, R.; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 395-403; In English; See also 20030068525; Original contains black and white illustrations; No Copyright; Avail: CASI; A02, Hardcopy

This paper gives an overview on diamond-like carbon (DLC) coatings in biomedical research and applications. DLC is a class of materials with shows an excellent biocompatibility as well as very good tribological properties. By the incorporation

of additional elements into the DLC all of these properties can be changed within a certain range. The amount of different proteins adsorbed on the surface can be influenced by the concentration of additional elements in the DLC film. These adsorbed proteins will then subsequently influence cell attachment, cell proliferation and cell differentiation. Certain toxic elements such as Cu, Ag, V, embedded in the DLC will, when exposed to a biological media, be released and cause toxic reactions. This allows the preparation of surfaces with a tunable antibacterial effect. Concerning the wear of UHMWPE cups operated against DLC coated hip joint balls, depending on the experimental setup, different results are found in the literature. Especially, the proteins adsorbed on the joint surfaces strongly influenced the wear results obtained. DLC coatings have an excellent haemocompatibility, which is expressed in a decreased thrombus formation. DLC coated cardiovascular implants such as artificial heart valves, blood pumps and stents are already commercially available.
Author
Diamonds; Adsorption; Cells (Biology); Biocompatibility; Diamond Films; Coatings

20030068740 Scripps Research Inst., La Jolla, CA, USA
RNA-Catalyzed RNA Ligation on an External RNA Template
McGinness, Kathleen E.; Joyce, Gerald F.; Chemistry & Biology; 2002; ISSN 1074-5521; 9, pp. 297-307; In English
Contract(s)/Grant(s): NAG5-4546; Copyright; Avail: Other Sources

Variants of the hc ligase ribozyme, which catalyzes ligation of the 3' end of an RNA substrate to the 5' end of the ribozyme, were utilized to evolve a ribozyme that catalyzes ligation reactions on an external RNA template. The evolved ribozyme catalyzes the joining of an oligonucleotide 3'-hydroxyl to the 5'-triphosphate of an RNA hairpin molecule. The ribozyme can also utilize various substrate sequences, demonstrating a largely sequence-independent mechanism for substrate recognition. The ribozyme also carries out the ligation of two oligonucleotides that are bound at adjacent positions on a complementary template. Finally, it catalyzes addition of mononucleoside '5-triphosphates onto the '3 end of an oligonucleotide primer in a template-dependent manner. The development of ribozymes that catalyze polymerase-type reactions contributes to the notion that an RNA world could have existed during the early history of life on Earth.
Author
Ribonucleic Acids; Catalysis; Enzymes

20030068889 NASA Glenn Research Center, Cleveland, OH, USA
Removal of Biologically Active Organic Contaminants using Atomic Oxygen
Banks, Bruce A., Inventor; Banks, Michael A., Inventor; Banks, Eric B., Inventor; May 06, 2003; 12 pp.; In English
Patent Info.: Filed 23 Jun. 2000; US-Patent-6,558,621; US-Patent-Appl-SN-606227; NASA-Case-LEW-161871-1; No Copyright; Avail: CASI; A03, Hardcopy

Biomedical devices that are to come into contact with living tissue, such as prosthetic and other implants for the human body and the containers used to store and transport them, are together cleaned of non-living, but biologically active organic materials, including endotoxins such as lipopolysaccharides, and assembled into a hermetically sealed package without recontamination. This is achieved by cleaning both the device and package components together in an apparatus, which includes a hermetically sealed chamber, in which they are contacted with atomic oxygen which biocleans them, by oxidizing the biologically active organic materials. The apparatus also includes means for manipulating the device and container and hermetically sealing the cleaned device into the cleaned container to form the package. A calibrated witness coupon visually indicates whether or not the device and container have received enough exposure to the atomic oxygen to have removed the organic materials from their surfaces. Gamma radiation is then used to sterilize the device in the sealed container.
Official Gazette of the U.S. Patent and Trademark Office
Activity (Biology); Cleaning; Contaminants; Organic Materials

20030068891 NASA Ames Research Center, Moffett Field, CA, USA
Advanced Sensor Systems for Biotelemetry
Hines, John W., Inventor; Somps, Christopher J., Inventor; Ricks, Robert D., Inventor; Mundt, Carsten W., Inventor; June 24, 2003; 17 pp.; In English; US-Patent-6,582,365 US-Patent; Avail: CASI; A03, Hardcopy

The present invention relates to telemetry-based sensing systems that continuously measures physical, chemical and biological parameters. More specifically, these sensing systems comprise a small, modular, low-power implantable biotelemetry system capable of continuously sensing physiological characteristics using implantable transmitters, a receiver, and a data acquisition system to analyze and record the transmitted signal over several months. The preferred embodiment is a preterm labor and fetal monitoring system. Key features of the invention include Pulse Interval Modulation (PIM) that is

used to send temperature and pressure information out of the biological environment. The RF carrier frequency is 174-216 MHz and a pair of RF bursts (pulses) is transmitted at a frequency of about 1-2 Hz. The transmission range is 3 to 10 feet, depending on the position of the transmitter in the body and its biological environment. The entire transmitter is encapsulated in biocompatible silicone rubber. Power is supplied by on-board silver-oxide batteries. The average power consumption of the current design is less than 30 microW, which yields a lifetime of approximately 6 - 9 months. Chip-on-Board technology (COB) drastically reduces the size of the printed circuit board from 38 x 28 mm to 22 x 8 mm. Unpackaged dies are flip-chip bonded directly onto the printed circuit board, along with surface mount resistors and capacitors. The invention can monitor additional physiological parameters including, but not limited to, ECG, blood gases, glucose, and ions such as calcium, potassium, and sodium.

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

Biotelemetry; Data Acquisition; Electrocardiography; Physiology; Pulse Modulation; Bioassay

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 Sciences*. For the effects of space on animals and plants see *51 Life Sciences*.

20030068026

Summary of Research Adaptions of Visceral and Cerebral Resistance Arteries to Simulated Microgravity

Delp, Michael; [2003]; 11 pp.; In English

Contract(s)/Grant(s): NAG2-1340; No Copyright; Avail: CASI; A03, Hardcopy

The proposed studies were designed address the effects of simulated microgravity on vascular smooth muscle and endothelial cell function in resistance arteries isolated from visceral tissues (spleen, mesentery and kidneys) and cerebrum. Alterations in vascular function induced by microgravity are particularly relevant to the problems of orthostatic intolerance and reduced exercise capacity experienced by astronauts upon re-entry into the earth's gravitational field. Decrements in contractile function or enhanced vasodilatory responsiveness of peripheral resistance arteries could lead to decreased peripheral resistance and orthostatic hypotension. Alternatively, augmentation of contractile function in cerebral resistance arteries could lead to increased cerebral vascular resistance and diminished perfusion of the brain. The Specific Aims and hypotheses were proposed in this grant. Following each of the Specific Aims, progress toward addressing that specific aim is presented. With the exception of Specific Aim VI (see aim for details), all aims have been experimentally addressed as proposed. The final six months of the granting period will be used for manuscript preparation; manuscripts in preparation will contain results from Specific Aims I-IV. Results from Specific Aims V and VI have been published.

Derived from text

Arteries; Cardiovascular System; Cerebrum; Cytology; Microgravity; Muscular Function; Computerized Simulation

20030068191 Arizona Univ., Tucson, AZ, USA

Measurement of Place Cell Firing in the Hippocampus in Space

McNaughton, Bruce L.; Knierim, James J.; Poe, Gina R.; Stengel, Casey; The Neurolab Spacelab Mission: Neuroscience Research in Space: Results from the STS-90, Neurolab Spacelab Mission; January 2003, pp. 245-247; In English; See also 20030068190; Original contains black and white illustrations; No Copyright; Avail: CASI; A01, Hardcopy

The goal of our experiment was to understand how the part of the brain that provides information on location and navigation (the hippocampus) encodes that knowledge. One way of addressing this question is to record the activity of neurons in the hippocampus while an animal performs various behavioral tasks. This kind of electrophysiological recording typically requires electrically shielded labs and a variety of amplifiers and computers to acquire, process, and display the signals. For spaceflight use, however, the system must be small, reliable, and able to provide the crewmembers data on whether useful information is being recorded. To meet these requirements, we designed a system that allowed the collection of complex neurophysiological measurements in space. The system was composed of an interface box, which connected to the electrodes measuring the brain signals and processed the multiplexed data, and a computer, which stored and displayed these signals. These two portable instruments contained all of the electronics necessary to perform in space what usually takes racks of equipment to perform in a laboratory on Earth. The system designed for spaceflight forms the basis of a state-of-the-art

commercial system now available to perform multichannel neurophysiological recordings in the laboratory.
Author
Hippocampus; Neurons; Electrophysiology; Measuring Instruments; Spacecraft Equipment

20030068193 Vanderbilt Univ., Nashville, TN, USA
The Human Sympathetic Nervous System Response to Spaceflight
Ertl, Andrew C.; Diedrich, Andre; Paranjape, Sachin Y.; Biaggioni, Italo; Robertson, Rose Marie; Lane, Lynda D.; Shiavi, Richard; Robertson, David; The Neurolab Spacelab Mission: Neuroscience Research in Space: Results from the STS-90, Neurolab Spacelab Mission; January 2003, pp. 197-202; In English; See also 20030068190
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The sympathetic nervous system is an important part of the autonomic (or automatic) nervous system. When an individual stands up, the sympathetic nervous system speeds the heart and constricts blood vessels to prevent a drop in blood pressure. A significant number of astronauts experience a drop in blood pressure when standing for prolonged periods after they return from spaceflight. Difficulty maintaining blood pressure with standing is also a daily problem for many patients. Indirect evidence available before the Neurolab mission suggested the problem in astronauts while in space might be due partially to reduced sympathetic nervous system activity. The purpose of this experiment was to identify whether sympathetic activity was reduced during spaceflight. Sympathetic nervous system activity can be determined in part by measuring heart rate, nerve activity going to blood vessels, and the release of the hormone norepinephrine into the blood. Norepinephrine is a neurotransmitter discharged from active sympathetic nerve terminals, so its rate of release can serve as a marker of sympathetic nervous system action. In addition to standard cardiovascular measurements (heart rate, blood pressure), we determined sympathetic nerve activity as well as norepinephrine release and clearance on four crewmembers on the Neurolab mission. Contrary to our expectation, the results demonstrated that the astronauts had mildly elevated resting sympathetic nervous system activity in space. Sympathetic nervous system responses to stresses that simulated the cardiovascular effects of standing (lower body negative pressure) were brisk both during and after spaceflight. We concluded that, in the astronauts tested, the activity and response of the sympathetic nervous system to cardiovascular stresses appeared intact and mildly elevated both during and after spaceflight. These changes returned to normal within a few days.
Author
Neurotransmitters; Sympathetic Nervous System; Human Beings; Physiological Responses; Space Flight; Spaceborne Experiments

20030068196 Arizona Univ., Tucson, AZ, USA
Ensemble Neural Coding of Place in Zero-G
McNaughton, Bruce L.; Knierim, James J.; Poe, Gina R.; The Neurolab Spacelab Mission: Neuroscience Research in Space: Results from the STS-90, Neurolab Spacelab Mission; January 2003, pp. 63-68; In English; See also 20030068190; Original contains black and white illustrations; No Copyright; Avail: CASI; A02, Hardcopy

One of the most disconcerting aspects of moving to a new city is the initial feeling of always being lost-of being unable to find your way in unfamiliar surroundings. Over time, as you explore the new environment, you begin to form a mental map that allows you to determine where you are at any given time, and to find where you want to go. Behavioral and physiological evidence implicates a particular structure of the brain, the hippocampus, and its related structures in the formation and maintenance of this cognitive map. The exact mechanisms by which the neurons in the hippocampus generate the map are still unknown. In the rat, hippocampal neurons fire selectively when the rat occupies particular locations in the environment. These place cells combine information from self-motion cues and from external landmarks to generate a neural code for spatial location. The nature of this interaction was investigated in the unique environment of microgravity on NASA s Neurolab Space Shuttle mission. Ensembles of 20-40 place cells were recorded as rats freely navigated a three-dimensional track that, in the absence of a gravitational reference framework, was expected to cause the rats self-motion cues to be in conflict with the external landmark cues. Under these conditions, place cell firing was abnormal in two of three rats tested on the fourth day of flight. The firing patterns of both of these rats returned to normal when tested on the ninth day of flight. These results reveal important aspects of the network interactions underlying place cell firing under normal conditions on Earth and provide a possible central neurophysiological correlate for the disorientation experienced by many astronauts during the first days of spaceflight.
Author
Neurophysiology; Weightlessness; Space Missions; Space Flight; Aerospace Medicine

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Sleep, Circadian Rhythms, and Performance During Space Shuttle Missions

Neri, David F.; Czeisler, Charles A.; Dijk, Derk-Jan; Wyatt, James K.; Ronda, Joseph M.; Hughes, Rod J.; The Neurolab Spacelab Mission: Neuroscience Research in Space Results from the STS-90, Neurolab Spacelab Mission; January 2003, pp. 211-221; In English; See also 20030068190; Original contains black and white illustrations

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Sleep and circadian rhythms may be disturbed during spaceflight, and these disturbances can affect crewmembers' performance during waking hours. The mechanisms underlying sleep and circadian rhythm disturbances in space are not well understood, and effective countermeasures are not yet available. We investigated sleep, circadian rhythms, cognitive performance, and light-dark cycles in five astronauts prior to, during, and after the 16-day STS-90 mission and the IO-day STS-95 mission. The efficacy of low-dose, alternative-night, oral melatonin administration as a countermeasure for sleep disturbances was evaluated. During these missions, scheduled rest activity cycles were 20-35 minutes shorter than 24 hours. Light levels on the middeck and in the Spacelab were very low; whereas on the flight deck (which has several windows), they were highly variable. Circadian rhythm abnormalities were observed. During the second half of the missions, the rhythm of urinary cortisol appeared to be delayed relative to the sleep-wake schedule. Performance during wakefulness was impaired. Astronauts slept only about 6.5 hours per day, and subjective sleep quality was lower in space. No beneficial effects of melatonin (0.3 mg administered prior to sleep episodes on alternate nights) were observed. A surprising finding was a marked increase in rapid eye movement (REM) sleep upon return to Earth. We conclude that these Space Shuttle missions were associated with circadian rhythm disturbances, sleep loss, decrements in neurobehavioral performance, and alterations in REM sleep homeostasis. Shorter than 24-hour rest-activity schedules and exposure to light-dark cycles inadequate for optimal circadian synchronization may have contributed to these disturbances.

Author

Circadian Rhythms; Sleep; Sleep Deprivation; Space Shuttle Missions; Spacelab; Astronaut Performance; Neurology

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Portable Sleep Monitoring System

Dijk, Derk-Jan; Buckey, Jay C., Jr.; Neri, David F.; Wyatt, James K.; Ronda, Joseph M.; Riel, Eymard; Prisk, G. Kim; West, John B.; Cziesler, Charles A., et al.; The Neurolab Spacelab Mission: Neuroscience Research in Space: Results from the STS-90, Neurolab Spacelab Mission; January 2003, pp. 249-251; In English; See also 20030068190; Original contains black and white illustrations; No Copyright; Avail: CASI; A01, Hardcopy

The sleep studies on Neurolab required detailed measurements to assess sleep accurately. On Earth, these measurements would typically be done in a fully equipped sleep laboratory. The operational demands of the Neurolab mission (limited space, power, and time) required a system that could perform all the usual sleep laboratory measurements in a small, portable package. The sleep system assembled for Neurolab included a special suit for measuring respiratory movements, sleep headgear that provided electroencephalography and eye movement data, and a portable recording device that could process and save the information. This system demonstrated that high-quality polysomnographic sleep data could be collected in a very demanding operational environment, and illustrates how sleep could also be monitored routinely in homes and clinics on Earth.

Author

Astronauts; Sleep; Data Recording; Eye Movements

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Perception of the Spatial Vertical During Centrifugation and Static Tilt

Clement, Gilles; Berthoz, Alain; Cohen, Bernard; Moore, Steven; Curthoys, Ian; Dai, Mingjia; Koizuka, Izumi; Kubo, Takeshi; Raphan, Theodore; The Neurolab Spacelab Mission: Neuroscience Research in Space: Results from the STS-90, Neurolab Spacelab Mission; January 2003, pp. 5-10; In English; See also 20030068190; Original contains black and white illustrations; No Copyright; Avail: CASI; A02, Hardcopy

The otolith organs in the inner ear utilize small crystals to sense both gravity and body movements. They determine whether an individual is upright or tilted by sensing gravity. They also sense whether an individual is translating; Le., moving side-to-side, up-and-down, or from front-to-back. Often the inner ear receives a combination of inputs. For example, when a motorcycle rider turns a sharp corner, the rider's otoliths sense the combined effects of turning and gravity. In spaceflight, the inner ear no longer senses gravity because the astronauts are weightless. However, inputs from side-to-side, up-down, and front-back translation still persist. Since tilt with regard to gravity is essentially meaningless in space, it has been hypothesized that, as a result of the process of adaptation to weightlessness, the brain begins to reinterpret all otolith signals to indicate

primarily translation, not tilt. This experiment tested that hypothesis using a human-rated centrifuge. This centrifuge generated constant centrifugal forces, similar to those experienced by the motorcycle rider in a tight turn. Astronauts riding in the centrifuge during orbital flight were tested to evaluate whether they perceived the centrifugal accelerations as tilt or translation. Results showed that all subjects perceived tilt, but that the magnitude of the perceived tilt changed throughout the mission. Only after two weeks in space did the perceived tilt match the actual direction of centripetal acceleration. The results indicate that orientation to gravitoinertial acceleration is maintained in space and the tilt-translation hypothesis was not supported. The findings also provided valuable experience for the use of artificial gravity during long-term or planetary exploration missions. Author

Otolith Organs; Sensory Perception; Attitude (Inclination); Human Centrifuges; Statics; Neurology; Vertical Orientation

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Ocular Counter-Rolling During Centrifugation and Static Tilt

Cohen, Bernard; Clement, Gilles; Moore, Steven; Curthoys, Ian; Dai, Mingjia; Koizuka, Izumi; Kubo, Takeshi; Raphan, Theodore; The Neurolab Spacelab Mission: Neuroscience Research in Space: Results from the STS-90, Neurolab Spacelab Mission; January 2003, pp. 11-17; In English; See also 20030068190

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Activation of the gravity sensors in the inner ear-the otoliths-generates reflexes that act to maintain posture and gaze. Ocular counter-rolling (OCR) is an example of such a reflex. When the head is tilted to the side, the eyes rotate around the line of sight in the opposite direction (i.e., counter-rolling). While turning comers, undergoing centrifugation, or making side-to-side tilting head movements, the OCR reflex orients the eyes towards the sum of the accelerations from body movements and gravity. Deconditioning of otolith-mediated reflexes following adaptation to microgravity has been proposed as the basis of many of the postural, locomotor, and gaze control problems experienced by returning astronauts. Evidence suggests that OCR is reduced postflight in about 75% of astronauts tested; but the data are sparse, primarily due to difficulties in recording rotational eye movements. During the Neurolab mission, a short-arm human centrifuge was flown that generated sustained sideways accelerations of 0.5-G and one-G to the head and upper body. This produces OCR; and so for the first time, the responses to sustained centrifugation could be studied without the influence of Earth's gravity on the results. This allowed us to determine the relative importance of sideways and vertical acceleration in the generation of OCR. This also provided the first test of the effects of exposure to artificial gravity in space on postflight otolith-ocular reflexes. There was little difference between the responses to centrifugation in microgravity and on Earth. In both conditions, the induced OCR was roughly proportional to the applied acceleration, with the OCR magnitude during 0.5-G centrifugation approximately 60% of that generated during one-G centrifugation. The overall mean OCR from the four payload crewmembers in response to one-G of sideways acceleration was 5.7 plus or minus 1.1 degree (mean and SD) on Earth. Inflight one-G centrifugation generated 5.7 plus or minus 1.1 degree of OCR, which was a small but significant decrease in OCR magnitude. The postflight OCR was 5.9 plus or minus 1.4 degree, which was not significantly different from preflight values. During both 0.5-G and one-G centrifugation in microgravity, where the head vertical gravitational component was absent, the OCR magnitude was not significantly different from that produced by an equivalent acceleration during static tilt on Earth. This suggests that the larger OCR magnitude observed during centrifugation on Earth was due to the larger body vertical linear acceleration component, which may have activated either the otoliths or the body tilt receptors. In contrast to previous studies, there was no decrease in OCR gain postflight. Our findings raise the possibility that inflight exposure to artificial gravity, in the form of intermittent one-G and 0.5-G centripetal acceleration, may have been a countermeasure to deconditioning of otolith-based orientation reflexes.

Author

Human Centrifuges; Otolith Organs; Attitude (Inclination); Aerospace Medicine; Head Movement; Oculomotor Nerves

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The Role of Visual Cues in Microgravity Spatial Orientation

Oman, Charles M.; Howard, Ian P.; Smith, Theodore; Beall, Andrew C.; Natapoff, Alan; Zacher, James E.; Jenkin, Heather L.; The Neurolab Spacelab Mission: Neuroscience Research in Space: Results from the STS-90, Neurolab Spacelab Mission; January 2003, pp. 69-81; In English; See also 20030068190; Original contains black and white illustrations

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In weightlessness, astronauts must rely on vision to remain spatially oriented. Although gravitational down cues are missing, most astronauts maintain a subjective vertical -a subjective sense of which way is up. This is evidenced by anecdotal reports of crewmembers feeling upside down (inversion illusions) or feeling that a floor has become a ceiling and vice versa (visual reorientation illusions). Instability in the subjective vertical direction can trigger disorientation and space motion

sickness. On Neurolab, a virtual environment display system was used to conduct five interrelated experiments, which quantified: (a) how the direction of each person's subjective vertical depends on the orientation of the surrounding visual environment, (b) whether rolling the virtual visual environment produces stronger illusions of circular self-motion (circular vection) and more visual reorientation illusions than on Earth, (c) whether a virtual scene moving past the subject produces a stronger linear self-motion illusion (linear vection), and (d) whether deliberate manipulation of the subjective vertical changes a crewmember's interpretation of shading or the ability to recognize objects. None of the crew's subjective vertical indications became more independent of environmental cues in weightlessness. Three who were either strongly dependent on or independent of stationary visual cues in preflight tests remained so inflight. One other became more visually dependent inflight, but recovered postflight. Susceptibility to illusions of circular self-motion increased in flight. The time to the onset of linear self-motion illusions decreased and the illusion magnitude significantly increased for most subjects while free floating in weightlessness. These decreased toward one-G levels when the subject 'stood up' in weightlessness by wearing constant force springs. For several subjects, changing the relative direction of the subjective vertical in weightlessness-either by body rotation or by simply cognitively initiating a visual reorientation-altered the illusion of convexity produced when viewing a flat, shaded disc. It changed at least one person's ability to recognize previously presented two-dimensional shapes. Overall, results show that most astronauts become more dependent on dynamic visual motion cues and some become responsive to stationary orientation cues. The direction of the subjective vertical is labile in the absence of gravity. This can interfere with the ability to properly interpret shading, or to recognize complex objects in different orientations.
Author
Visual Stimuli; Vertical Orientation; Astronauts; Spacecrews

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Neural Re-adaptation to Earth's Gravity Following Return From Space
Highstein, Stephen M.; Boyle, Richard; Mensinger, Allen F.; Yoshida, Kaoru; Usui, Shiro; Tricas, Timothy; Intravaia, Anthony; The Neurolab Spacelab Mission: Neuroscience Research in Space: Results from the STS-90, Neurolab Spacelab Mission; January 2003, pp. 45-49; In English; See also 20030068190
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The gravity sensors in the inner ear (the utricle and saccule) no longer receive strong gravitational signals in weightlessness. In an effort to compensate for the reduced input, these sensors may become more sensitive using a process called up-regulation. If this happens, the output of the vestibular nerve from the inner ear would be greatly increased after a space mission, when the sensitized gravity sensors are reexposed to gravity. We believe that information gathered by studying the inner ear of a lower animal, such as a fish, will provide the information needed to prove this. Despite evolution, the balance and equilibrium functions of the inner ear have not appreciably changed since their appearance in the earliest vertebrates. As a result, the fish vestibular system compares favorably in both structure and function with that of mammals. By chronically recording the output of the vestibular system in the fish (specifically the output from the utricle), the question of how microgravity affects the output of the inner ear could be answered precisely. For five days following two NASA Shuttle flights, we recorded from the vestibular nerves supplying the utricle the responses to inertial accelerations (head movements) in four oyster toadfish (Opsanus tau). Within the first day postflight, the magnitude of response to an applied translation (side-to-side) movement was on average three times greater than for controls. The reduced gravitational acceleration in orbit apparently resulted in an up-regulation of the sensitivity of the utricle. By 30 hours postflight, responses were statistically similar to control. The time course of return to normal sensitivity parallels the reported decrease in vestibular disorientation and improvement in balance in astronauts following their return from space.
Author
Adaptation; Earth Gravitation; Space Transportation System Flights; NASA Space Programs; Aerospace Medicine; Neurology

20030068203 Centre National de la Recherche Scientifique, Paris, France
The Brain as a Predictor: On Catching Fly Balls in Zero-G
McIntyre, Joseph; Zago, Myrka; Berthoz, Alain; Lacquaniti, Francesco; The Neurolab Spacelab Mission: Neuroscience Research in Space: Results from the STS-90, Neurolab Spacelab Mission; January 2003, pp. 55-61; In English; See also 20030068190; Original contains black and white illustrations; No Copyright; Avail: CASI; A02, Hardcopy

The art of intercepting a flying ball has preoccupied athletes and sports fans for centuries. Moreover, the ability to intercept or avoid a moving object-whether it be to catch a ball, snatch prey, or avoid the path of a predator- is a skill that has been acquired by almost every evolved species. This behavior, remarkable in that it requires anticipation of future events, is thus a fundamental property of biological sensorimotor systems. Yet the mechanisms have yet to be clearly identified that

allow the brain to predict the future positions of a moving object, rather than simply perceiving where that moving object is now. In this study, we addressed an unresolved question in the fields of psychology and neuroscience: Does the brain rely strictly on sensory information to estimate the movements of an object, or can we improve our performance on interceptive tasks by using knowledge about how the world works? We used the microgravity conditions of the Neurolab Space Shuttle mission to examine this question as it applies to catching a 'falling' ball. Astronauts caught a ball projected downward from the ceiling with one of three different speeds. The astronauts triggered anticipatory motor responses slightly earlier (with respect to impact) in flight than on the ground, with a greater timing shift for lower ball velocities. Data derived from this show that the central nervous system uses an internal model of gravitational acceleration, in addition to sensory information, to predict the time-to-contact between the ball and the hand and applies this model by default-whether on Earth or in microgravity.
Author
Central Nervous System; Microgravity; Astronauts

20030068204 Medical Coll. of Wisconsin, Milwaukee, WI, USA
Neuromuscular Development Is Altered by Spaceflight
Riley, Danny A.; Wong-Riley, Margaret T. T.; The Neurolab Spacelab Mission: Neuroscience Research in Space: Results from the STS-90, Neurolab Spacelab Mission; January 2003, pp. 105-109; In English; See also 20030068190; Original contains black and white illustrations; No Copyright; Avail: CASI; A01, Hardcopy

Weightbearing skeletal muscles, also known as antigravity muscles, lift the body's weight against gravity. Studies show that periodic weightbearing activity is important for muscle maintenance in adults, but it is not known how critical weightbearing is for the early development of muscles and the nerves that serve them. We predicted that raising young rats in microgravity to eliminate weightbearing by the hindlimbs would compromise the nerve and muscle development of the soleus-a weightbearing leg muscle. The nonweightbearing extensor digitorum longus (EDL) leg muscle, however, should develop normally. To test this, we examined the spinal cords, soleus muscles, and EDL muscles collected from six young rats on inflight day 15 of the Neurolab mission. These were compared with ground samples from age-matched controls in vivarium and flight cages. Interpretation of the findings was complicated by the fact that the space-flown rats grew significantly less than normal, in part related to decreased interaction with the nursing mother rats. Soleus development was the most disrupted as evidenced by decreased muscle fiber growth, increased sensitivity to muscle reloading injury, reduced growth of motor neuron terminals as well as a lowered ability of the nerves to use oxygen. Surprisingly, the normal process of eliminating multiple connections to muscle fibers proceeded without weightbearing activity. The importance of loaded contractile activity for maintenance of adult muscle mass has been recognized for many years. The present findings suggest that normal neuromuscular development depends upon loaded contractions during the formative period.
Author
Muscular Function; Musculoskeletal System; Neuromuscular Transmission; Space Flight; Space Missions; Microgravity

20030068205 Texas Univ. Health Science Center, San Antonio, TX, USA
Early Development of Gravity-Sensing Organs in Microgravity
Wiederhold, Michael L.; Gao, Wenyuan; Harrison, Jeffrey L.; Parker, Kevin A.; The Neurolab Spacelab Mission: Neuroscience Research in Space: Results from the STS-90, Neurolab Spacelab Mission; January 2003, pp. 123-132; In English; See also 20030068190; Original contains black and white illustrations
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Most animals have organs that sense gravity. These organs use dense stones (called otoliths or statoconia), which rest on the sensitive hairs of specialized gravity- and motion-sensing cells. The weight of the stones bends the hairs in the direction of gravitational pull. The cells in turn send a coded representation of the gravity or motion stimulus to the central nervous system. Previous experiments, in which the eggs or larvae of a marine mollusk (Aplysia californica, the sea hare) were raised on a centrifuge, demonstrated that the size of the stones (or test mass) was reduced in a graded manner as the gravity field was increased. This suggests that some control mechanism was acting to normalize the weight of the stones. The experiments described here were designed to test the hypothesis that, during their initial development, the mass of the stones is regulated to achieve a desired weight. If this is the case, we would expect a larger-than-normal otolith would develop in animals reared in the weightlessness of space. To test this, freshwater snails and swordtail fish were studied after spaceflight. The snails mated in space, and the stones (statoconia) in their statocysts developed in microgravity. Pre-mated adult female swordtail fish were flown on the Space Shuttle, and the developing larvae were collected after landing. Juvenile fish, where the larval development had taken place on the ground, were also flown. In snails that developed in space, the total volume of statoconia forming the test mass was 50% greater than in size-matched snails reared in functionally identical equipment on the ground. In the

swordtail fish, the size of otoliths was compared between ground- and flight-reared larvae of the same size. For later-stage larvae, the growth of the otolith was significantly greater in the flight-reared fish. However, juvenile fish showed no significant difference in otolith size between flight- and ground-reared fish. Thus, it appears that fish and snails reared in space do produce larger-than-normal otoliths (or their analogs), apparently in an attempt to compensate for the reduced weight of the stones in space. The fish data suggest that there is a critical period during which altered gravity can affect the size of the test mass, since the larval, but not the juvenile, fish showed the changes.
Author
Gravireceptors; Microgravity; Aerospace Medicine; Animals; Space Transportation System Flights

20030068206 Massachusetts Inst. of Tech., Cambridge, MA, USA
Neurolab Virtual Environment Generator
Oman, Charles M.; The Neurolab Spacelab Mission: Neuroscience Research in Space: Results from the STS-90, Neurolab Spacelab Mission; January 2003, pp. 253-257; In English; See also 20030068190; Original contains black and white illustrations; No Copyright; Avail: CASI; A01, Hardcopy

A virtual environment generator (VEG) computer graphics workstation, along with associated subject interface devices and restraint system, was developed to support the sensory-motor and performance investigations aboard the STS-90 Neurolab mission. The VEG was a custom-designed, low-power-consumption, rack-mounted Windows NT-based 200-MHz PC graphics workstation equipped with a wide field-of-view (64 degreesx48 degrees) color, stereo liquid crystal head-mounted display. The system also included an electronics box, interfaces for Spacelab data, a keyboard, a flat panel display, a headset, microphones, and a thigh-mounted joystick. Software included a Session Manager graphical user interface, as well as Experiment and Archive Managers to render scenes, collect data, and analyze results for individual experiments. Other accessories included an optical headhand tracker (not flown) and a subject restraint system (SRS). When wearing the SRS, the subject could connect the harness at each hip to a pair of floor-mounted 147 Newton (33-pound) constant force springs. This force would pull the subject toward the floor of the Spacelab and allow the crewmember to 'stand' in weightlessness. Alternatively, the springs could be disconnected and the crewmember would float with only light restraint provided by cloth tethers. Science results obtained using the Neurolab VEG are described in the accompanying article by Oman, et al. The VEG served as a prototype for a higher performance virtual-reality system under development for the International Space Station. OBJECTIVES When the Neurolab mission was conceived in the early 1990s, virtual-reality (VR) technology had advanced to the point where NASA advisory committees realized it could be exploited in space neuroscience studies, human factors research, and even onboard crew training. One recommendation was that a flightqualified VR system be developed for use on Spacelab missions. Progress in producing real-time computer images, tracking head movements, and generating both auditory and tactile stimuli allowed scientists to create completely artificial environments and virtual objects, and experiment with new types of 'immersive' human computer interfaces. NASA working groups and university workshops defined preliminary requirements for the system, based on research needs and current or soon-to-be-available technology. Proposals to use the system were solicited for Neurolab (NASA, 1993). Responsibility for the development was assigned to the Integrated Project Development Laboratory in the Space and Life Sciences Directorate at Johnson Space Center. Lockheed Martin Engineering Services (LMES) served as the contractor. Scientists from two sensory-motor and performance experiments tentatively selected for the mission served informally as advisors. The virtual environment generator (VEG) workstation also ultimately served as a prototype for the International Space Station Human Research Facility graphics workstation.
Author
Spacelab; Sensorimotor Performance; Virtual Reality; Astronauts

20030068207 Mount Sinai School of Medicine, New York, NY, USA
Inflight Central Nervous System Tissue Fixation for Ultrastructural Studies
Holstein, Gay R.; Martinelli, Giorgio P.; The Neurolab Spacelab Mission: Neuroscience Research in Space: Results from the STS-90, Neurolab Spacelab Mission; January 2003, pp. 259-262; In English; See also 20030068190; Original contains black and white illustrations
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The cerebellum is a brain structure critical for coordination, timing muscle contractions during movement, and motor learning. Anatomical studies have shown that neurons in the cerebellum are structurally modifiable. These investigations have demonstrated changes in neuron shape, as well as in the three-dimensional structure of the specialized contacts between nerve cells (synapses) as a result of altered behavioral experiences. Physiological studies have provided some insight into the functional significance of those structural modifications in the performance of motor tasks. The objective of our Neurolab experiment was to evaluate the fine structure of the cerebellum at several time points during and following spaceflight in order

to identify architectural alterations in the rat cerebellum that correlate with the adaptation to microgravity, and re-adaptation to Earth s gravity. This required the ability to preserve (fix) the tissue acquired in space so that it could be analyzed after landing.
Author
Psychomotor Performance; Gravitational Effects; Cerebellum

20030068208 Pisa Univ., Italy
Gene Expression in the Rat Brain During Spaceflight
Pompeiano, Ottavio; d'Ascanio, Paola; Centini, Claudia; Pompeiano, Maria; Cirelli, Chiara; Tononi, Giulio; The Neurolab Spacelab Mission: Neuroscience Research in Space: Results from the STS-90, Neurolab Spacelab Mission; January 2003, pp. 27-37; In English; See also 20030068190; Original contains black and white illustrations
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The vestibular system senses the position and movement of the head in space, controls the activity of postural and eye muscles, influences the cardiovascular and respiratory systems, and monitors body orientation. During spaceflight, astronauts show: (a) changes in balance and eye movements; (b) alterations in the control of cardiovascular and respiratory activities; (c) changes in body orientation and perception; and (d) sleep disturbances. After flight, balance is changed markedly. These deficits are compensated over time. The compensation for these changes involves plasticity-the ability of nerves to make new connections or to use existing connections in different ways. One way to determine which nervous structures are involved in plasticity is to measure changes in immediate early genes (IEGs). Changes in neural activity produce changes in the expression of IEGs, such as c-fos and FRAs (fos-related antigens). The products from these IEGs can be detected within minutes after stimulation, while the corresponding proteins produced by activating these genes persist for hours (Fos) or days (FRAs). Fos and FRAs can also affect the expression of other genes. These, in turn, may convert the nerve activation induced during spaceflight into short-term or long-term biochemical responses. Such molecular changes may thus contribute to the plastic events responsible for adaptation to zero-G and the re-adaptation to one-G. We measured Fos and FRAs to identify the cellular and molecular changes occurring during spaceflight. The entire brain (except for the cerebellum) of 24 adult male albino rats (Fisher 344 rats) was studied at different time points of the spaceflight and compared to the entire brain of 48 control rats. Changes in Fos and/or FRAs expression were observed in the following brain structures: (a) the vestibular nuclei, which control posture and eye movements either directly or through other brain structures, such as the inferior olive and the lateral reticular nucleus; (b) the nucleus of the tractus solitarius (NTS) (the nucleus of the solitary tract) and other areas involved in the spontaneous and reflex regulation of cardiovascular and respiratory functions; (c) the area postrema (AP), which plays a role in motion sickness; (d) the central nucleus of the amygdala, a structure that is functionally related to both the NTS and the AP; (e) cortical and subcortical areas involved in body orientation and perception; (f) hypothalamic and brain stem nuclei, such as the locus coeruleus, involved in the regulation of the sleep-wake cycle. The results identified the brain regions most affected by the adaptation to weightlessness and the re-adaptation to Earth's gravity.
Author
Brain; Gene Expression; Gravitational Effects; Spaceborne Experiments; Rats; Vestibules; Aerospace Medicine

20030068209 NASA Ames Research Center, Moffett Field, CA, USA
Ribbon Synaptic Plasticity in Gravity Sensors of Rats Flown on Neurolab
Ross, Muriel D.; Varelas, Joseph; The Neurolab Spacelab Mission: Neuroscience Research in Space: Results from the STS-90, Neurolab Spacelab Mission; January 2003, pp. 39-44; In English; See also 20030068190; Original contains black and white illustrations
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Previous spaceflight experiments (Space Life Sciences-1 and -2 (SLS-1 and SLS-2)) first demonstrated the extraordinary ability of gravity sensor hair cells to change the number, kind, and distribution of connections (synapses) they make to other cells while in weightlessness. The number of synapses in hair cells in one part of the inner ear (the utricle) was markedly elevated on flight day 13 (FD13) of SLS-2. Unanswered questions, however, were whether these increases in synapses occur rapidly and whether they remain stable in weightlessness. The answers have implications for long-duration human space travel. If gravity sensors can adapt quickly, crews may be able to move easily between different gravity levels, since the sensors will adapt rapidly to weightlessness on the spacecraft and then back to Earth's gravity when the mission ends. This ability to adapt is also important for recovery from balance disorders. To further our understanding of this adaptive potential (a property called neuronal synaptic plasticity), the present Neurolab research was undertaken. Our experiment examined whether: (a) increases in synapses would remain stable throughout the flight, (b) changes in the number of synapses were uniform across different portions of the gravity sensors (the utricle and saccule), and (c) synaptic changes were similar for the

different types of hair cells (Type I and Type II). Utricular and saccular maculae (the gravity-sensing portions of the inner ear) were collected in flight from rats on FD2 and FD14. Samples were also collected from control rats on the ground. Tissues were prepared for ultrastructural study. Hair cells and their ribbon synapses were examined in a transmission electron microscope. Synapses were counted in all hair cells in 50 consecutive sections that crossed the striolar zone. Results indicate that utricular hair cell synapses initially increased significantly in number in both types of hair cells by FD2. Counts declined by FD14, but the mean number of synapses in utricular Type II cells remained significantly higher than in the ground control rats. For saccular samples, synaptic number in Type I and Type II cells declined on FD2, but returned to near-baseline values by FD14. These findings indicate that: (a) synaptic plasticity occurs rapidly in weightlessness, and (b) synaptic changes are not identical for the two types of hair cells or for the two maculae.
Author
Plastic Properties; Rats; Ribbons; Spaceborne Experiments; Life Sciences; Gravireceptors; Synapses; Neurophysiology

20030068210 German Sports Univ., Cologne, Germany
Visual-motor Coordination During Spaceflight
Bock, Otmar; Fowler, Barry; Comfort, Deanna; Juengling, Susanne; The Neurolab Spacelab Mission: Neuroscience Research in Space: Results from the STS-90, Neurolab Spacelab Mission; January 2003, pp. 83-89; In English; See also 20030068190; No Copyright; Avail: CASI; A02, Hardcopy

We applied a battery of tests to study the motor skills of astronauts. An intriguing pattern of findings was revealed. In weightlessness, subjects slowed down when performing a pointing and a grasping task, but not when executing a tracking and a reaction-time task. The accuracy of their responses was little affected by weightlessness in any of our tasks. To explain this task-specific pattern of changes, we propose a three-component hypothesis, according to which manual dexterity depends on the required speed and accuracy, and also on the amount of processing power allocated by the brain to each given task. Depending on actual or presumed task constraints, subjects can keep accuracy high by reducing speed, with no change in processing cost, or they can keep both accuracy and speed high by allocating more processing power.
Author
Sensorimotor Performance; Manned Space Flight; Aerospace Medicine; Physiological Responses; Visual Acuity

20030068211 California Univ., Irvine, CA, USA
Gravity Plays an Important Role in Muscle Development and the Differentiation of Contractile Protein Phenotype
Adams, Gregory A.; Haddad, Fadia; Baldwin, Kenneth M.; The Neurolab Spacelab Mission: Neuroscience Research in Space: Results from the STS-90, Neurolab Spacelab Mission; January 2003, pp. 111-122; In English; See also 20030068190; Original contains black and white illustrations
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Several muscles in the body exist mainly to work against gravity. Whether gravity is important in the development of these muscles is not known. By examining the basic proteins that compose muscle, questions about the role of gravity in muscle development can be answered. Myosin heavy chains (MHCs) are a family of proteins critically important for muscle contraction. Several types of MHCs exist (e.g., neonatal, slow, fast), and each type is produced by a particular gene. Neonatal MHCs are produced early in life. Slow MHCs are important in antigravity muscles, and fast MHCs are found in fast-twitch power muscles. The gene that is turned on or expressed will determine which MHC is produced. Early in development, antigravity skeletal muscles (muscles that work against gravity) normally produce a combination of the neonatal/embryonic MHCs. The expression of these primitive MHCs is repressed early in development; and the adult slow and fast MHC genes become fully expressed. We tested the hypothesis that weightbearing activity is critical for inducing the normal expression of the slow MHC gene typically expressed in adult antigravity muscles. Also, we hypothesized that thyroid hormone, but not opposition to gravity, is necessary for expressing the adult fast IIb MHC gene essential for high-intensity muscle performance. Groups of normal thyroid and thyroid-deficient neonatal rats were studied after their return from the 16-day Neurolab mission and compared to matched controls. The results suggest: (1) Weightlessness impaired body and limb skeletal muscle growth in both normal and thyroid-deficient animals. Antigravity muscles were impaired more than those used primarily for locomotion andor nonweightbearing activity. (2) Systemic and muscle expression of insulin-like growth factor-I (IGF-I), an important body and tissue growth factor, was depressed in flight animals. (3) Normal slow, type I MHC gene expression was markedly repressed in the normal thyroid flight group. (4) Fast IIb MHC gene expression was enhanced in fast-twitch muscles of normal thyroid animals exposed to spaceflight; however, thyroid deficiency markedly repressed expression of this gene independently of spaceflight. In summary, the absence of gravity, when imposed at critical stages of development, impaired body and skeletal muscle growth, as well as expression of the MHC gene family of motor proteins. This suggests that normal

weightbearing activity is essential for establishing body and muscle growth in neonatal animals, and for expressing the motor gene essential for supporting antigravity functions.
Author
Weightlessness; Gravitational Effects; Muscles; Proteins

20030068212 Mount Sinai School of Medicine, New York, NY, USA
The Effect of Spaceflight on the Ultrastructure of the Cerebellum
Holstein, Gay R.; Martinelli, Giorgio P.; The Neurolab Spacelab Mission: Neuroscience Research in Space: Results from the STS-90, Neurolab Spacelab Mission; January 2003, pp. 19-25; In English; See also 20030068190; Original contains black and white illustrations
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In weightlessness, astronauts and cosmonauts may experience postural illusions as well as motion sickness symptoms known as the space adaptation syndrome. Upon return to Earth, they have irregularities in posture and balance. The adaptation to microgravity and subsequent re-adaptation to Earth occurs over several days. At the cellular level, a process called neuronal plasticity may mediate this adaptation. The term plasticity refers to the flexibility and modifiability in the architecture and functions of the nervous system. In fact, plastic changes are thought to underlie not just behavioral adaptation, but also the more generalized phenomena of learning and memory. The goal of this experiment was to identify some of the structural alterations that occur in the rat brain during the sensory and motor adaptation to microgravity. One brain region where plasticity has been studied extensively is the cerebellar cortex-a structure thought to be critical for motor control, coordination, the timing of movements, and, most relevant to the present experiment, motor learning. Also, there are direct as well as indirect connections between projections from the gravity-sensing otolith organs and several subregions of the cerebellum. We tested the hypothesis that alterations in the ultrastructural (the structure within the cell) architecture of rat cerebellar cortex occur during the early period of adaptation to microgravity, as the cerebellum adapts to the absence of the usual gravitational inputs. The results show ultrastructural evidence for neuronal plasticity in the central nervous system of adult rats after 24 hours of spaceflight. Qualitative studies conducted on tissue from the cerebellar cortex (specifically, the nodulus of the cerebellum) indicate that ultrastructural signs of plasticity are present in the cerebellar zones that receive input from the gravity-sensing organs in the inner ear (the otoliths). These changes are not observed in this region in cagematched ground control animals. The specific changes include the formation of lamellar bodies, profoundly enlarged Purkinje cell mitochondria, the presence of inter-neuronal cellular protrusions in the molecular layer, and signs of degeneration in the distal dendrites of the Purkinje cells. Since these morphologic signs are not apparent in the control animals, they are not likely to be due to caging or tissue processing effects. The particular nature of the structural alterations in the nodulus, most notably the formation of lamellar bodies and the presence of degeneration, further suggests that excitotoxicity (damaging overstimulation of neurons) may play a role in the short-term neural response to spaceflight. These findings suggest a structural basis for the neuronal and synaptic plasticity accompanying the central nervous system response to altered gravity and help identify the cellular bases underlying the vestibular abnormalities experienced by astronauts during periods of adaptation and re-adaptation to different gravitational forces. Also, since the short- and long-term changes in neural structure occurring during such periods of adaptation resemble the neuronal alterations that occur in some neurologic disorders such as stroke, these findings may offer guidance in the development of strategies for rehabilitation and treatment of such disorders.
Author
Cerebellum; Aerospace Medicine; Gravitational Effects; Manned Space Flight; Neurology

20030068213 New York Univ., New York, NY, USA
Motor System Development Depends on Experience: A Microgravity Study of Rats
Walton, Kerry D.; Llinas, Rodolfo R.; Kalb, Robert; Hillman, Dean; DeFelipe, Javier; Garcia-Segura, Luis Miguel; The Neurolab Spacelab Mission: Neuroscience Research in Space: Results from the STS-90, Neurolab Spacelab Mission; January 2003, pp. 95-103; In English; See also 20030068190; Original contains black and white illustrations
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Animals move about their environment by sensing their surroundings and making adjustments according to need. All animals take the force of gravity into account when the brain and spinal cord undertake the planning and execution of movements. To what extent must animals learn to factor in the force of gravity when making neural calculations about movement? Are animals born knowing how to respond to gravity, or must the young nervous system learn to enter gravity into the equation? To study this issue, young rats were reared in two different gravitational environments (the one-G of Earth and the microgravity of low Earth orbit) that necessitated two different types of motor operations (movements) for optimal behavior. We inquired whether those portions of the young nervous system involved in movement, the motor system, can adapt

to different gravitational levels and, if so, the cellular basis for this phenomenon. We studied two groups of rats that had been raised for 16 days in microgravity (eight or 14 days old at launch) and compared their walking and righting (ability to go from upside down to upright) and brain structure to those of control rats that developed on Earth. Flight rats were easily distinguished from the age-matched ground control rats in terms of both motor function and central nervous system structure. Mature surface righting predominated in control rats on the day of landing (R+O), while immature righting predominated in the flight rats on landing day and 30 days after landing. Some of these changes appear to be permanent. Several conclusions can be drawn from these studies: (1) Many aspects of motor behavior are preprogrammed into the young nervous system. In addition, several aspects of motor behavior are acquired as a function of the interaction of the developing organism and the rearing environment; (2) Widespread neuroanatomical differences between one-G- and microgravity-reared rats indicate that there is a structural basis for the adaptation to the rearing environment. These observations provide support for the idea that an animal's motor system adapts for optimal function within the environment experienced during a critical period in early postnatal life.
Author
Adaptation; Microgravity; Spaceborne Experiments; Nervous System

20030068214 Montpellier-2 Univ., France
Development of the Vestibular System in Microgravity
Raymond, Jacqueline; Dechesne, Claude J.; Dememes, Danielle; Blanc, Emmanuelle; The Neurolab Spacelab Mission: Neuroscience Research in Space: Results from the STS-90, Neurolab Spacelab Mission; January 2003, pp. 143-149; In English; See also 20030068190; Original contains black and white illustrations
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We investigated the effects of weightlessness on both the development of a gravity sensor (the utricle in the inner ear) and on the relay of information from this sensor to the brain. Since gravity provides the principal sensory stimulus for the utricle, exposure to spaceflight markedly reduces sensory inputs to this organ. If this were to occur in the developing nervous system, the lack of sensory input might result in changes in utricle organization and, consequently, in the wiring in brain areas where the utricle sends its information. To test this hypothesis, we exposed developing rats (eight days old at launch) to weightlessness for 16 days on the Neurolab mission. In the utricle, we observed no effect of microgravity on sensory cells and neuron connections. In the brain, however, neuron development in the vestibular nuclei of the flight rats was affected. The most striking effect was a lack of connections into the vestibular nuclei from the part of the brain concerned with balance and coordination of movement (the cerebellum). These observations suggest that the lack of gravity did have an effect on the development of nerve connections in the brain, but not in the gravity sensor itself. The areas most affected were the vestibular nuclei and the cerebellum. These results suggest that gravity may be important for the normal development of the balance system.
Author
Microgravity; Nervous System; Vestibules; Gravireceptors; Space Flight; Nuclei (Cytology)

20030068215 Ulm Univ., Germany
The Development of an Insect Gravity Sensory System in Space (Crickets in Space)
Horn, Eberhard R.; Kaemper, Guenter; Neubert, Juegen; The Neurolab Spacelab Mission: Neuroscience Research in Space: Results from the STS-90, Neurolab Spacelab Mission; January 2003, pp. 133-142; In English; See also 20030068190; Original contains black and white illustrations; No Copyright; Avail: CASI; A02, Hardcopy

Our Neurolab experiment CRISP (Crickets in Space) examined the balance between genetics and gravity in the development of a gravity-sensing system. Crickets are an excellent model to study this balance since they possess easily accessible external gravity receptors and a simple nervous system. Information from the gravity sensors travels through a pair of neurons called position-sensitive interneurons (PSIS), and is used to keep the cricket's head stable when its body rolls from side to side. In addition, injured gravity sensors can regenerate if they are damaged during development. It is not known, however, if they would regenerate normally if gravity were not present. Crickets at four developmental stages (eggs, first-, fourth-, and sixth-stage larvae) were sent into space for 16 days to explore the possibility of an age-related sensitivity to microgravity. Another group of crickets was exposed to high gravity levels (three-G) for the same amount of time. One gravity sensor was removed from the sixth-stage larvae so that regeneration could be studied. In intact larvae and larvae with a removed sensor, postflight experiments revealed that the behavioral response (maintenance of head position with body tilt) had a low susceptibility to microgravity. In contrast, the activity of the PSIs revealed a significant sensitivity to microgravity. Nerve firing was significantly reduced in microgravity-exposed larvae, but this recovered after 14 days of re-adaptation to one-G. Parts of the brain where gravitational information is integrated with other senses were not modified by weightlessness

exposure. Crickets exposed to three-G revealed no effects on behavior but showed a significant developmental retardation of PSI physiology during one-G re-adaptation. Absence of prominent behavioral effects either early after weightlessness or after three-G exposure may be caused by a fast one-G re-adaptation supported by inputs from other sensors such as position sense and vision. The results demonstrate that the development of the gravity-sensing system is governed not only by genetic programs but also by gravitational experience.
Author
Crickets; Sensory Perception; Weightlessness; Gravireceptors

20030068217 Brigham and Women's Hospital, Boston, MA, USA
Neural Development Under Conditions of Spaceflight
Kosik, Kenneth S.; Steward, Oswald; Temple, Meredith D.; Denslow, Maria J.; The Neurolab Spacelab Mission: Neuroscience Research in Space: Results from the STS-90, Neurolab Spacelab Mission; January 2003, pp. 161-168; In English; See also 20030068190; Original contains black and white illustrations
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One of the key tasks the developing brain must learn is how to navigate within the environment. This skill depends on the brain's ability to establish memories of places and things in the environment so that it can form cognitive maps. Earth's gravity defines the plane of orientation of the spatial environment in which animals navigate, and cognitive maps are based on this plane of orientation. Given that experience during early development plays a key role in the development of other aspects of brain function, experience in a gravitational environment is likely to be essential for the proper organization of brain regions mediating learning and memory of spatial information. Since the hippocampus is the brain region responsible for cognitive mapping abilities, this study evaluated the development of hippocampal structure and function in rats that spent part of their early development in microgravity. Litters of male and female Sprague-Dawley rats were launched into space aboard the Space Shuttle Columbia on either postnatal day eight (P8) or 14 (P14) and remained in space for 16 days. Upon return to Earth, the rats were tested for their ability to remember spatial information and navigate using a variety of tests (the Morris water maze, a modified radial arm maze, and an open field apparatus). These rats were then tested physiologically to determine whether they exhibited normal synaptic plasticity in the hippocampus. In a separate group of rats (flight and controls), the hippocampus was analyzed using anatomical, molecular biological, and biochemical techniques immediately postlanding. There were remarkably few differences between the flight groups and their Earth-bound controls in either the navigation and spatial memory tasks or activity-induced synaptic plasticity. Microscopic and immunocytochemical analyses of the brain also did not reveal differences between flight animals and ground-based controls. These data suggest that, within the developmental window studied, microgravity has minimal long-term impact on cognitive mapping function and cellular substrates important for this function. Any differences due to development in microgravity were transient and returned to normal soon after return to Earth.
Author
Attitude (Inclination); Hippocampus; Rats; Microgravity

20030068218 Medicine and Dentistry Univ. of New Jersey, Piscataway, NJ, USA
The Effect of Weightlessness on the Developing Nervous System
Nowakowski, Richard S.; Hayes, Nancy L.; The Neurolab Spacelab Mission: Neuroscience Research in Space: Results from the STS-90, Neurolab Spacelab Mission; January 2003, pp. 169-173; In English; See also 20030068190; Original contains black and white illustrations; No Copyright; Avail: CASI; A01, Hardcopy

As the brain develops, cells proliferate, and then their progeny migrate to the locations they will occupy in the adult brain where they differentiate. These events involve interactions both between cells and between organelles within cells. The buoyancy of the cells and organelles can affect these interactions. On Earth, gravity is responsible for maintaining the buoyancy of organelles and cells, and in the weightless condition of space these differences are lost. We tested the hypothesis that the loss of these differences will disrupt cell proliferation and migration within a particular part of the brain-the neocortex. To study these developmental processes, the developing brains of prenatal mice were labeled during spaceflight with two markers of DNA synthesis (tritiated thymidine and bromodeoxyuridine). These brains were preserved in fixative, stored in the cold, and returned to Earth for study after the flight. The postflight analysis showed there were significant differences in the development of the brains of fetal mice in space vs. those maintained in identical conditions at the Kennedy Space Center. Detailed work to determine precisely how brain development is modified continues as these specimens are being further analyzed. This experiment demonstrated that complex studies on brain development can be performed successfully in space.
Author
Nervous System; Weightlessness; Gravitational Effects; Aerospace Medicine; Space Flight

20030068219 Texas Univ., Dallas, TX, USA

Neural Control of the Cardiovascular System in Space

Levine, Benjamin D.; Pawelczyk, James A.; Zuckerman, Julie; Zhang, Rong; Fu, Qi; Iwasaki, Kenichi; Ray, Chet; Blomqvist, C. Gunnar; Lane, Lynda D.; Giller, Cole A., et al.; The Neurolab Spacelab Mission: Neuroscience Research in Space: Results from the STS-90, Neurolab Spacelab Mission; January 2003, pp. 175-185; In English; See also 20030068190; Original contains black and white illustrations

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During the acute transition from lying supine to standing upright, a large volume of blood suddenly moves from the chest into the legs. To prevent fainting, the blood pressure control system senses this change immediately, and rapidly adjusts flow (by increasing heart rate) and resistance to flow (by constricting the blood vessels) to restore blood pressure and maintain brain blood flow. If this system is inadequate, the brain has a backup plan. Blood vessels in the brain can adjust their diameter to keep blood flow constant. If blood pressure drops, the brain blood vessels dilate; if blood pressure increases, the brain blood vessels constrict. This process, which is called autoregulation, allows the brain to maintain a steady stream of oxygen, even when blood pressure changes. We examined what changes in the blood pressure control system or cerebral autoregulation contribute to the blood pressure control problems seen after spaceflight. We asked: (1) does the adaptation to spaceflight cause an adaptation in the blood pressure control system that impairs the ability of the system to constrict blood vessels on return to Earth?; (2) if such a defect exists, could we pinpoint the neural pathways involved?; and (3) does cerebral autoregulation become abnormal during spaceflight, impairing the body s ability to maintain constant brain blood flow when standing upright on Earth? We stressed the blood pressure control system using lower body negative pressure, upright tilt, handgrip exercise, and cold stimulation of the hand. Standard cardiovascular parameters were measured along with sympathetic nerve activity (the nerve activity causing blood vessels to constrict) and brain blood flow. We confirmed that the primary cardiovascular effect of spaceflight was a postflight reduction in upright stroke volume (the amount of blood the heart pumps per beat). Heart rate increased appropriately for the reduction in stroke volume, thereby showing that changes in heart rate regulation alone cannot be responsible for orthostatic hypotension after spaceflight. All of the astronauts in our study had an increase in sympathetic nerve activity during upright tilting on Earth postflight. This increase was well calibrated for the reduction in stroke volume induced by the upright posture. The results obtained from stimulating the sympathetic nervous system using handgrip exercise or cold stress were also entirely normal during and after spaceflight. No astronaut had reduced cerebral blood flow during upright tilt, and cerebral autoregulation was normal or even enhanced inflight. These experiments show that the cardiovascular adaptation to spaceflight does not lead to a defect in the regulation of blood vessel constriction via sympathetic nerve activity. In addition, cerebral autoregulation is well-maintained. It is possible that despite the increased sympathetic nerve activity, blood vessels did not respond with a greater degree of constriction than occurred preflight, possibly uncovering a limit of vasoconstrictor reserve.

Author

Astronauts; Blood Pressure; Cardiovascular System; Sympathetic Nervous System

20030068220 Medical Coll. of Virginia, Richmond, VA, USA

Influence of Microgravity on Arterial Baroreflex Responses Triggered by Valsalva's Maneuver

Eckberg, Dwain L.; Cox, James F.; Tahvanainen, Kari U. O.; Kuusela, Tom A.; Cooke, William H.; Ames, Jimey E.; The Neurolab Spacelab Mission: Neuroscience Research in Space: Results from the STS-90, Neurolab Spacelab Mission; January 2003, pp. 187-195; In English; See also 20030068190; Original contains black and white illustrations

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When astronauts return to Earth and stand upright, their heart rates may speed inordinately, their blood pressures may fall, and some returning astronauts may even faint. Since physiological adjustments to standing are mediated importantly by pressure-regulating reflexes (baroreflexes), we studied involuntary (or autonomic) nerve and blood pressure responses of astronauts to four, 15-second periods of 15- and 30-mmHg straining (Valsalva'.~ maneuver). We measured the electrocardiogram, finger blood pressure, respiration, and muscle sympathetic nerve activity in four healthy male astronauts before and during the 16-day Neurolab Space Shuttle mission. We found that although microgravity provoked major autonomic changes, no astronaut experienced fainting symptoms after the mission. Blood pressure fell more during straining in space than on Earth (the average reduction of systolic pressure with 30-mmHg straining was 49 mmHg during and 27 mmHg before the mission). However, the increases of muscle sympathetic nerve activity that were triggered by straining were also larger in space than on Earth. As a result, the gain of the sympathetic baroreflex, taken as the total sympathetic nerve response divided by the maximum pressure reduction during straining, was the same in space as on Earth. In contrast, heart rate changes, which are mediated by changes of vagus nerve activity, were smaller in space. This and earlier research suggest that exposure to microgravity augments blood pressure and sympathetic adjustments to Valsalva straining and differentially

reduces vagal, but not sympathetic baroreflex responsiveness. The changes that we documented can be explained economically as a consequence of the blood volume reduction that occurs in space.
Author
Astronauts; Blood Pressure; Physiological Responses

20030068221 California Univ., San Diego, CA, USA
Sleep and Respiration in Microgravity
West, John B.; Elliott, Ann R.; Prisk, G. Kim; Paiva, Manuel; The Neurolab Spacelab Mission: Neuroscience Research in Space: Results from the STS-90, Neurolab Spacelab Mission; January 2003, pp. 223-232; In English; See also 20030068190; Original contains black and white illustrations
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Sleep is often reported to be of poor quality in microgravity, and studies on the ground have shown a strong relationship between sleep-disordered breathing and sleep disruption. During the 16-day Neurolab mission, we studied the influence of possible changes in respiratory function on sleep by performing comprehensive sleep recordings on the payload crew on four nights during the mission. In addition, we measured the changes in the ventilatory response to low oxygen and high carbon dioxide in the same subjects during the day, hypothesizing that changes in ventilatory control might affect respiration during sleep. Microgravity caused a large reduction in the ventilatory response to reduced oxygen. This is likely the result of an increase in blood pressure at the peripheral chemoreceptors in the neck that occurs when the normally present hydrostatic pressure gradient between the heart and upper body is abolished. This reduction was similar to that seen when the subjects were placed acutely in the supine position in one-G. In sharp contrast to low oxygen, the ventilatory response to elevated carbon dioxide was unaltered by microgravity or the supine position. Because of the similarities of the findings in microgravity and the supine position, it is unlikely that changes in ventilatory control alter respiration during sleep in microgravity. During sleep on the ground, there were a small number of apneas (cessation of breathing) and hypopneas (reduced breathing) in these normal subjects. During sleep in microgravity, there was a reduction in the number of apneas and hypopneas per hour compared to preflight. Obstructive apneas virtually disappeared in microgravity, suggesting that the removal of gravity prevents the collapse of upper airways during sleep. Arousals from sleep were reduced in microgravity compared to preflight, and virtually all of this reduction was as a result of a reduction in the number of arousals from apneas and hypopneas. We conclude that any sleep disruption in microgravity is not the result of respiratory factors.
Author
Microgravity; Respiration; Sleep; Neurology; Space Flight; Space Missions

20030068222 Deutsche Forschungsanstalt fuer Luft- und Raumfahrt, Cologne, Germany
Blood Pooling and Plasma Filtration in the Thigh in Microgravity
Baisch, Friedheim J.; Beck, E. J.; Gerzer, R.; Moller, K.; Wesseling, K. H.; Drummer, C.; Heer, M.; Karemaker, J. M.; The Neurolab Spacelab Mission: Neuroscience Research in Space: Results from the STS-90, Neurolab Spacelab Mission; January 2003, pp. 203-205; In English; See also 20030068190; No Copyright; Avail: CASI; A01, Hardcopy

When moving from lying down to standing on Earth, some blood moves out of the chest and into the legs. Measurements of leg circumference and leg volume show that they both increase with standing and decrease when lying down. Most of the blood that moves into the leg stays in the blood vessels, but some of the blood plasma will filter out of the blood vessels into the spaces surrounding the muscle cells. This space is called the interstitial space. Filtration of fluid into the interstitial spaces increases when the pressure in blood vessels is high and decreases when pressure in the blood vessels is low. Determining how much of a change in leg volume is due to changes in the amount of blood in blood vessels or to alterations in interstitial fluid (or to other factors) is challenging. This information is important, however, since nerve fibers in the muscles (metaboreceptors) may sense the interstitial volume and signal the nervous system to control interstitial fluid content. In weightlessness, leg volume decreases markedly. We hypothesized that interstitial fluid volume would also be reduced. We used electrical impedance tomography (EIT) to determine the changes in fluid volume in the thigh before, during, and after spaceflight. Changes were measured at rest and with the application of lower body negative pressure (LBNP), since LBNP changes leg volume. Thigh circumference fell 11.5% (+/-2.1% SEM) inflight. The pooling of blood in the legs during LBNP (measured in arbitrary EIT units), increased more than twofold at 15 mmHg LBNP (3.9+/-2.6 preflight and 11.2+/-2.7 inflight) as well as at 30 mmHg LBNP (9.7+/-3.1 preflight and 28.0+/-3.6 inflight) compared to preflight. Postflight measurements did not differ significantly from preflight values. The filtration of plasma from the blood vessels into the interstitial space increased inflight 470%+/-145% at 15 mmHg LBNP and 278%+/-76% at 30 mmHg LBNP. We concluded that microgravity caused a reduction in thigh volume. The increased plasma filtration during LBNP showed that the fluid volume of the interstitial space of the lower limbs was significantly reduced inflight. The measurements support the hypothesis that receptors in the

musculature of the lower part of the body may sense a dehydrated state in microgravity.
Author
Blood Plasma; Blood; Thigh; Filtration; Microgravity

20030068223 California Univ., Davis, CA, USA
The Effects of Spaceflight on the Rat Circadian Timing System
Fuller, Charles A.; Murakami, Dean M.; Hoban-Higgins, Tana M.; Fuller, Patrick M.; Robinson, Edward L.; Tang, I.-Hsiung; The Neurolab Spacelab Mission: Neuroscience Research in Space: Results from the STS-90, Neurolab Spacelab Mission; January 2003, pp. 233-241; In English; See also 20030068190; Original contains black and white illustrations
Contract(s)/Grant(s): NAG2-944; NIH-HL-53205; No Copyright; Avail: CASI; A02, Hardcopy

Two fundamental environmental influences that have shaped the evolution of life on Earth are gravity and the cyclic changes occurring over the 24-hour day. Light levels, temperature, and humidity fluctuate over the course of a day, and organisms have adapted to cope with these variations. The primary adaptation has been the evolution of a biological timing system. Previous studies have suggested that this system, named the circadian (circa - about; dies - a day) timing system (CTS), may be sensitive to changes in gravity. The NASA Neurolab spaceflight provided a unique opportunity to evaluate the effects of microgravity on the mammalian CTS. Our experiment tested the hypotheses that microgravity would affect the period, phasing, and light sensitivity of the CTS. Twenty-four Fisher 344 rats were exposed to 16 days of microgravity on the Neurolab STS-90 mission, and 24 Fisher 344 rats were also studied on Earth as one-G controls. Rats were equipped with biotelemetry transmitters to record body temperature (T(sub b)) and heart rate (HR) continuously while the rats moved freely. In each group, 18 rats were exposed to a 24-hour light-dark (LD 12:12) cycle, and six rats were exposed to constant dim red-light (LL). The ability of light to induce a neuronal activity marker (c-fos) in the circadian pacemaker of the brain, the suprachiasmatic nucleus (SCN), was examined in rats studied on flight days two (FD2) and 14 (FD14), and postflight days two (R+1) and 14 (R+13). The flight rats in LD remained synchronized with the LD cycle. However, their T(sub b), rhythm was markedly phase-delayed relative to the LD cycle. The LD flight rats also had a decreased T(sub b) and a change in the waveform of the T(sub b) rhythm compared to controls. Rats in LL exhibited free-running rhythms of T(sub b), and HR; however, the periods were longer in microgravity. Circadian period returned to preflight values after landing. The internal phase angle between rhythms was different in flight than in one-G. Compared with control rats, the flight rats exhibited no change in HR. Finally, the LD FD2 flight rats demonstrated a reduced sensitivity to light as shown by significantly reduced c-fos expression in the SCN in comparison with controls. These findings constitute the first demonstration that microgravity affects the fundamental properties of the mammalian circadian timing system, specifically by influencing the clock's period, and its ability to maintain temporal organization and phase angle of synchronization to an external LD cycle.
Author
Circadian Rhythms; Rats; Microgravity; Gravitational Effects

20030068224 NASA Ames Research Center, Moffett Field, CA, USA
Chronic Recording of Regenerating VIIIth Nerve Axons with a Sieve Electrode
Highstein, Stephen M.; Mensinger, Allen F.; Anderson, David J.; Buchko, Christopher J.; Johnson, Michael A.; Martin, David C.; Tresco, Patrick A.; Silver, Robert B.; The Neurolab Spacelab Mission: Neuroscience Research in Space: Results from the STS-90, Neurolab Spacelab Mission; January 2003, pp. 271-273; In English; See also 20030068190; Original contains black and white illustrations
Contract(s)/Grant(s): NAG2-0945; NIH-R21-RR12623; NIH-NS-5-2322; NIH/NCRR-P41-RR09754-04; NSF AO93-OLMSA-02; No Copyright; Avail: CASI; A01, Hardcopy

One of the major goals of the Decade of the Brain (the 1990's) was the implementation of chronic interfaces to the nervous system. Such interfaces could serve as conduits for signal transmission past injured nerves or be used to control prostheses. One approach to this interface has been the sieve electrode. In this design, a small piece of silicon, with multiple small holes placed through it, is inserted into a nerve. Nerve fibers grow through the holes of the sieve and make contact with an electrode there. In this way, nerve traffic in the nerve fibers can be measured directly and signals can be introduced into the nerve. More than a quarter century has elapsed since the concept of the sieve electrode as a neural interface was first introduced, yet numerous technical difficulties have prevented its routine use. Hardware complications for a silicon-based wafer electrode have included difficulties in the consistent micromachining of quality electrodes, interfacing the microprobes with manageable recording leads, and developing transdermal (through the skin) connectors for continuous data acquisition. On the biological side, channeling of nerve fibers through the sieve pores has proven to be problematic even in nerves that exhibit vigorous regeneration. The present study reports consistent success and repeated sampling of multiple, single-regenerating axons via a transdermal connector in awake, unrestrained fish. Long-term, chronic recording has been achieved

by implanting a sieve electrode in the path of regenerating vestibular nerve fibers from the otolithic organs of a fish, Opsanus tau (oyster toadfish). This approach to nerve recording is ideal for spaceflight use (see science report by Boyle et al. in this publication) and also holds excellent promise for several clinical applications.
Author
Electrodes; Sieves; Axons; Nerves; Recording Instruments; Vestibules; Micromachining

20030068225 NASA Johnson Space Center, Houston, TX, USA
Surgery and Recovery in Space
Buckey, Jay C., Jr.; Williams, Dafydd R.; Riley, Danny A.; The Neurolab Spacelab Mission: Neuroscience Research in Space: Results from the STS-90, Neurolab Spacelab Mission; January 2003, pp. 275-277; In English; See also 20030068190; Original contains black and white illustrations; No Copyright; Avail: CASI; A01, Hardcopy

Nerves can have a profound effect on the skeletal muscles that they serve. To understand the development of antigravity muscles in weightlessness, it is important to study not only the muscles, but also their innervation. These nerves originate from motor neurons in the spinal cord. To study specific spinal neurons, they must be labeled to distinguish them from other nerve cells in the spinal cord. This is commonly done using retrograde labeling, which involves depositing a small amount of a label in the muscle of interest. The label is taken up by the motor nerve terminals and transported back up the nerve axons to the nerve cell body in the spinal cord. When tissue sections of the spinal cord are examined under a light microscope, labeled nerve cells serving the injected muscle are readily resolved. Performing retrograde labeling, however, presents technical challenges. First, for this experiment, the muscles to be labeled are very small-a millimeter or two in diameter-so the label must be injected in microliter quantities using a fine needle. Second, microsurgery is required to expose the muscle for accurate injection. Third, proper anesthesia and recovery techniques are essential to ensure that the rats can tolerate the procedure easily and recover without difficulty. Fourth, in space this must be done within a workstation that keeps the work area about an arm's length away from the eyes. For Neurolab, the procedures and techniques to perform recovery surgery were developed and used for the first time in space. Five, 21-day-old rats were anesthetized, and their soleus and extensor digitorum longus leg muscles were injected with label. The surgical incisions were closed with wound adhesive. All rats tolerated the procedure well, and they all recovered uneventfully. The wound sites were healing cleanly when examined two days after the surgery. The procedures worked well and demonstrate that, if needed in the future, challenging and delicate surgical procedures can be performed in space.
Author
Musculoskeletal System; Surgery; Weightlessness; Spaceborne Experiments; Neurology

20030068226 Vanderbilt Univ., Nashville, TN, USA
Microneurography System for Spaceflight Use
Ertl, Andrew C.; Limardo, Jose; Peterson, Rob; Pawelczyk, James A.; Pathak, Amit; Paranjape, Sachin Y.; Diedrich, Andre; Biaggioni, Italo; Robertson, Rose Marie; Robertson, David; The Neurolab Spacelab Mission: Neuroscience Research in Space: Results from the STS-90, Neurolab Spacelab Mission; January 2003, pp. 267-270; In English; See also 20030068190; Original contains black and white illustrations; No Copyright; Avail: CASI; A01, Hardcopy

The autonomic (or automatic) nervous system helps maintain a relatively constant blood pressure under varied everyday conditions. Blood pressure regulating reflexes, baroreflexes, control how fast and hard the heart contracts as well as the constriction or dilation of arterioles-the small muscular blood vessels that supply capillaries with blood. Arteriole constriction raises blood pressure and dilation lowers it, so the control of arterioles is a powerful way to regulate blood pressure. When blood pressure is high, nerve activity from the brain to the arterioles is low, allowing a relaxation of the arterioles. When blood pressure is low, increased nerve activity causes arterioles to constrict. This arteriolar control can be measured by detecting the nerve traffic to the arterioles using a specialized technique called microneurography. Microneurography involves placing a very small needle electrode in a nerve (such as the peroneal nerve near the knee) and recording signals from the appropriate nerve fibers. Microneurography has been instrumental in revealing the mechanisms involved in disease states such as cyclosporine-induced high blood pressure, congestive heart failure, and low blood pressure with standing. Microneurography can also be used to study the adaptation to spaceflight. After exposure to microgravity, astronauts show varying degrees of a syndrome known as orthostatic intolerance. The symptoms of orthostatic intolerance are lightheadedness and dizziness that can lead to the feeling of an impending faint (pre-syncope) or actual fainting (syncope) with sufficiently prolonged upright posture. Severe orthostatic intolerance while landing the Space Shuttle, or during an emergency after landing, could present a significant risk to the crew and the spacecraft. As a result, understanding this problem fully is a priority for NASA life scientists, and was a focus of the autonomic nervous system studies on Neurolab. In prior studies on orthostatic intolerance, information regarding the impact of microgravity on autonomic nervous system circulatory control had been largely inferred

from indirect measurements obtained preflight and postflight. With microneurography, the responses of the autonomic nervous system can be measured directly, and this ability helps answer longstanding questions about the cardiovascular adaptation to weightlessness. To use this technique in space, however, a compact, robust system that met rigorous safety standards was needed. Existing microneurography systems could not be used without undergoing modification. The University of Iowa s Department of Bioengineering produces a widely used research microneurography system. The unit was unsuitable for spaceflight, however, because it is packaged in a large, 19-in.-wide rack-mounted box and would take up too much space in a space vehicle. Also, the system was not designed to meet all of NASA s electrical safety requirements. In particular, current-limiters were needed in the preamplifier to prevent electrical shock if other protections failed. A portable, robust device that met all of NASA s requirements was needed to accomplish microneurography successfully on Neurolab. This report focuses on the development of the equipment and techniques used to measure sympathetic nerve traffic (microneurography) in humans during the Neurolab experiments.
Author
Nervous System; Microgravity; Blood Vessels; Bioinstrumentation

20030068227 Mount Sinai School of Medicine, New York, NY, USA
Adaptation to Linear Acceleration in Space (ATLAS) Experiments: Equipment and Procedures
Cohen, Bernard; Clement, Gilles; Moore, Steven; Curthoys, Ian; Dai, Mingjia; Koizuka, Izumi; Kubo, Takeshi; Raphan, Theodore; The Neurolab Spacelab Mission: Neuroscience Research in Space Results from the STS-90, Neurolab Spacelab Mission; January 2003, pp. 279-283; In English; See also 20030068190; Original contains black and white illustrations; No Copyright; Avail: CASI; A01, Hardcopy

During orbital spaceflight, the acceleration of gravity is reduced from one-G on the Earth's surface to about 10(exp -6)-G in orbit. Nevertheless, the head accelerations associated with changing direction and with turning are unaffected. Therefore, the body must selectively adapt to the relative absence of gravity. As a result of this reorganization, astronauts frequently exhibit difficulty with balance upon landing that could pose a serious problem if they had to function efficiently in a gravitational environment immediately after a long-duration spaceflight. They can also become disoriented when in motion. These deficits are as yet incompletely understood. The otoliths, located in the inner ear, sense head accelerations and generate reflexes to the eyes and postural muscles that maintain gaze and posture when moving in a gravitational environment. They are also directly involved in sensing the direction of gravity and contribute importantly to the sense of spatial orientation. It is likely that changes in otolith-mediated reflexes that occur as a result of adaptation to microgravity could be responsible for postflight problems with gaze and balance. The purpose of two Neurolab experiments (see science reports by Moore et al. and Clement et al. in this publication) was to study how spatial orientation and reflexes originating in the otolith organs might be affected by adaptation to microgravity. Flight and ground-based instruments were developed for the Neurolab mission to study how orienting otolith-ocular reflexes and the perception of the spatial vertical are changed by adaptation during spaceflight. These instruments included a flight-rated centrifuge that delivered measured amounts of linear acceleration along different body axes in flight, a functionally equivalent centrifuge to do ground-based testing, and an apparatus that statically tilted the head and body with regard to gravity before and after flight. The static tilt apparatus allowed the teams to obtain data that could be compared with the results of centrifugation. Binocular, infrared video-oculography, a noninvasive technique, was utilized to measure eye movements in three dimensions while the astronauts were being centrifuged. Equipment was also developed that could deliver visual stimuli to calibrate the induced eye movements and to induce optokinetic nystagmus (OKN) and ocular pursuit during centrifugation and static tilt. This report describes the development and use of this equipment. This unique hardware performed flawlessly in flight, provided the first inflight artificial gravity, and advanced the technology of eye movement recording.
Author
Adaptation; Acceleration Stresses (Physiology); Spaceborne Experiments; Human Centrifuges; Onboard Equipment; Microgravity; Long Duration Space Flight

20030068228 German Sports Univ., Cologne, Germany
Visual-Motor Coordination Facility (VCF)
Bock, Otmar; Fowler, Barry; Gates, Darrin; Liptikas, John; Geisen, Lutz; Mortimer, Alan; The Neurolab Spacelab Mission: Neuroscience Research in Space: Results from the STS-90, Neurolab Spacelab Mission; January 2003; 4 pp.; In English; See also 20030068190; Original contains black and white illustrations; No Copyright; Avail: CASI; A01, Hardcopy

Astronauts' anecdotal observations, surveys of video footage, and recent quantitative studies suggest that handeye coordination (visual-motor coordination) may be degraded during spaceflight. To better understand the fundamental role gravity plays in coordinating movement, and to determine human performance limitations on space missions, detailed,

well-controlled studies on visual-motor coordination are needed. Careful recording of movements such as grasping, pointing, and tracking targets can reveal a great deal about the adaptations taking place during spaceflight. Experiments during space missions differ dramatically from typical laboratory research, imposing very high demands on equipment and procedures. Since space and mass are both limited on missions, the hardware should be small and lightweight. Also, since developing space-qualified equipment is expensive, the hardware should be deployable for a number of different experimental objectives. Setup and operation of the equipment should be simple, since the crewmembers will have a variety of backgrounds, time is limited during space missions, and the principal investigator is not readily available to supervise operations. To meet these constraints, we designed the Visual-motor Coordination Facility (VCF) according to the - fits into a single Spacelab locker - easy to set up and stow - no calibration or signal quality judgements needed - turnkey operation - largely automated nominal procedures - largely automated error diagnostics To accommodate a variety of experimental paradigms for present and future use, the VCF employs computer- generated visual objects as stimuli. The subject can then point at, grasp, or track the visual object presented. The size, location, and movement of the target object are freely programmable depending on the skill to be tested. The VCF registers the positions of one or two fingers of one hand and, using computer control, can allow or prevent visual feedback about the hand movements. A trigger switch is also available to measure reaction times or other responses. The VCF is a compact, versatile, easy-to use device for the testing of visual-motor skills. In addition to space applications, the VCF could be useful for visual-motor skill testing on Earth, particularly in mobile, nonlaboratory scenarios.
Author
Sensorimotor Performance; Astronauts

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MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

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

20030067753 Newcastle-upon-Tyne Univ., Newcastle
When Mental Models go Wrong. Co-occurrences in Dynamic, Critical Systems
Besnard, D.; Greathead, D.; Apr. 2003; 16 pp.; In English
Report No.(s): PB2003-105176; CS-TR-790; Copyright; Avail: National Technical Information Service (NTIS)

This short paper is intended to highlight an interesting psychological phenomenon affecting the accuracy of mental models. It occurs when two events happen as expected by an operator but for reasons that are actually not understood. In other words, a mental model of a problem is erroneously taken to be valid as a result of a mere co-occurrence. We discuss this phenomenon with the example of a real commercial air crash. We finally address some implications for systems' design and support tools.
NTIS
Cognitive Psychology; Dynamical Systems; Human Performance

20030067788
Interface Changes Generating Accidents. A Schema-Driven Approach of Negative Transfer
Cacitti, L.; Besnard, D.; Jan. 2003; 24 pp.; In English
Report No.(s): PB2003-105204; CS-TR-784; Copyright; Avail: National Technical Information Service (NTIS)

When expert operators interact with a new device, they inevitably reuse former interaction modes and actions. This phenomenon is due to the human cognition seeking resources savings. Schemas support this strategy and are implemented in such a way that perfection is disregarded at the profit of an intuitive trade-off between performance and cognitive resources savings. As a consequence, humans have a strong inclination to fit well-known solution procedures into new problems. For this reason, changes in work environments can cause accidents when they allow operators to erroneously interact with a new device if the latter is perceived as familiar. This research issue originates from an industrial background. The suspected cause of a fatal error performed by an operator in a steelworks factory is replicated in a simple experiment. The results support the hypothesis according to which errors (and eventually accidents) due to changes are more likely when the latter do not inhibit irrelevant former interaction modes. This main result is discussed under the angle of cognitive psychology.
NTIS
Cognitive Psychology; Accidents; Human Factors Engineering; Industrial Plants

20030067833 Army Aeromedical Research Lab., Fort Rucker, AL

Noise Attenuation of the HGU-56/P Aircrew Integrated Helmet System When Worn with the Combat Vehicle Crewman Hood (BALACLAVA)

Robinette, Martin B.; Ahroon, William A.; Ostler, Dale A.; May 2003; 33 pp.; In English

Report No.(s): AD-A414820; USAARL-2003-10; No Copyright; Avail: CASI; A03, Hardcopy

The HGU-56/P Aircrew Integrated Helmet System (AIMS) is designed to provide impact protection and noise attenuation to U.S. Army rotary-wing aircraft crewmembers. The ability of any helmet to attenuate environmental noise depends on an adequate seal between the earcup and the user's head. Any object (e.g., eyeglass frames) or practice (e.g., loose chin strap) that interferes with the seal between the earcup and the head will compromise both helmet retention (with resultant effects on impact protection) and noise attenuation. The noise attenuation of the HGU-56/P AIMS was measured with and without the flight approved balaclava (combat vehicle crewmember hood). The balaclava interferes with the earcup seal and adversely affects the noise attenuation of the MGU-56/P AIMS. When worn without the additional hearing protection provided by earplugs or the Communications Sarplug, the balaclava can significantly affect operational capabilities. Results obtained from using minimal fitting instructions did not differ from those obtained using the ANSI Sl2.6-l997 Experimenter-supervised fit method. Care must be taken to fit the flight helmet correctly in order to ensure adequate noise and impact protection.

DTIC

Helmets; Noise Reduction; Protection

20030067844 NASA Ames Research Center, Moffett Field, CA, USA

Biological Visualization, Imaging and Simulation(Bio-VIS) at NASA Ames Research Center: Developing New Software and Technology for Astronaut Training and Biology Research in Space

Smith, Jeffrey; March 11, 2003; 1 pp.; In English; IEEE Computer Society Virtual Reality 2003 Conference, 2003, Los Angeles, CA, USA; No Copyright; Avail: Other Sources; Abstract Only

The Bio- Visualization, Imaging and Simulation (BioVIS) Technology Center at NASA's Ames Research Center is dedicated to developing and applying advanced visualization, computation and simulation technologies to support NASA Space Life Sciences research and the objectives of the Fundamental Biology Program. Research ranges from high resolution 3D cell imaging and structure analysis, virtual environment simulation of fine sensory-motor tasks, computational neuroscience and biophysics to biomedical/clinical applications. Computer simulation research focuses on the development of advanced computational tools for astronaut training and education. Virtual Reality (VR) and Virtual Environment (VE) simulation systems have become important training tools in many fields from flight simulation to, more recently, surgical simulation. The type and quality of training provided by these computer-based tools ranges widely, but the value of real-time VE computer simulation as a method of preparing individuals for real-world tasks is well established. Astronauts routinely use VE systems for various training tasks, including Space Shuttle landings, robot arm manipulations and extravehicular activities (space walks). Currently, there are no VE systems to train astronauts for basic and applied research experiments which are an important part of many missions. The Virtual Glovebox (VGX) is a prototype VE system for real-time physically-based simulation of the Life Sciences Glovebox where astronauts will perform many complex tasks supporting research experiments aboard the International Space Station. The VGX consists of a physical display system utilizing duel LCD projectors and circular polarization to produce a desktop-sized 3D virtual workspace. Physically-based modeling tools (Arachi Inc.) provide real-time collision detection, rigid body dynamics, physical properties and force-based controls for objects. The human-computer interface consists of two magnetic tracking devices (Ascention Inc.) attached to instrumented gloves (Immersion Inc.) which co-locate the user's hands with hand/forearm representations in the virtual workspace. Force-feedback is possible in a work volume defined by a Phantom Desktop device (SensAble inc.). Graphics are written in OpenGL. The system runs on a 2.2 GHz Pentium 4 PC. The prototype VGX provides astronauts and support personnel with a real-time physically-based VE system to simulate basic research tasks both on Earth and in the microgravity of Space. The immersive virtual environment of the VGX also makes it a useful tool for virtual engineering applications including CAD development, procedure design and simulation of human-system systems in a desktop-sized work volume.

Author

Scientific Visualization; Environment Simulation; Display Devices; Astronaut Training

20030067916 NASA Marshall Space Flight Center, Huntsville, AL, USA

Enhancing the Human Factors Engineering Role in an Austere Fiscal Environment

Stokes, Jack W.; May 09, 2003; 10 pp.; In English; 33rd International Conference on Environmental Systems (SAE), 7-10 Jul. 2003, Vancouver, British Columbia, Canada; No Copyright; Avail: CASI; A02, Hardcopy

An austere fiscal environment in the aerospace community creates pressures to reduce program costs, often minimizing

or sometimes even deleting the human interface requirements from the design process. With an assumption that the flight crew can recover real time from a poorly human factored space vehicle design, the classical crew interface requirements have been either not included in the design or not properly funded, though carried as requirements. Cost cuts have also affected quality of retained human factors engineering personnel. In response to this concern, planning is ongoing to correct the acting issues. Herein are techniques for ensuring that human interface requirements are integrated into a flight design, from proposal through verification and launch activation. This includes human factors requirements refinement and consolidation across flight programs; keyword phrases in the proposals; closer ties with systems engineering and other classical disciplines; early planning for crew-interface verification; and an Agency integrated human factors verification program, under the One NASA theme. Importance is given to communication within the aerospace human factors discipline, and utilizing the strengths of all government, industry, and academic human factors organizations in an unified research and engineering approach. A list of recommendations and concerns are provided in closing.
Author
Human Factors Engineering; Systems Engineering; Aircraft Industry; NASA Space Programs

20030067976 Naval Postgraduate School, Monterey, CA
The Wireless Ubiquitous Surveillance Testbed
Ford, Michael K.; Dennis, LeRoy P., III; Mar. 2003; 125 pp.; In English; Original contains color illustrations
Report No.(s): AD-A414846; No Copyright; Avail: CASI; A06, Hardcopy

The thesis research examines the emergence of surveillance and biometrics technologies as a sensible baseline for building a ubiquitous surveillance testbed for the Naval Postgraduate School, This thesis also defines what ubiquitous surveillance is, employs biometric applications and technical strategies to build a working testbed, and addresses developmental issues surrounding the hypothesis for a ubiquitous surveillance testbed. The authors conduct several evaluations of the testbed in using different scenarios, We recommend emerging biometric and surveillance technologies can promote the maturation of the testbed into a premier ubiquitous habitat,
DTIC
Test Stands; Surveillance; Biometrics

20030068015 Army Aeromedical Research Lab., Fort Rucker, AL
Analysis of Head Motion in Rotary-Wing Flight Using Various Helmet-Mounted Display Configurations (Part I. Azimuth)
Rostad, Ryan J.; Rash, Clarence E.; Briley, Joshua K.; Mora, John C.; Crowley, John S.; Apr. 2003; 182 pp.; In English
Report No.(s): AD-A414823; USAARL-2003-07; No Copyright; Avail: CASI; A09, Hardcopy

In spite of an immense increase in interest in helmet-mounted displays (HMDs) over the past two decades, there have been few studies on head motion while using HMDs in operational flight Rotary-wing flights conducted using a number of HMD configurations have resulted in a head position database that will be useful in filling this void. Azimuth head position data have been analyzed for a slalom flight maneuver for four visual environments: good visual environment (daytime, unaided), night vision goggles, HMD with thermal imagery, and HMD with thermal imagery and symbology. The major thread throughout these analyses was that the pilots exhibited greatest head motion for the NVG environment. The two HMD configurations (TIO and RWS) were very similar in exhibited head motion, not indicating any significant differences between the TIO FLIR imagery alone and the RWS FLIR imagery plus symbology. Based on this analysis of the head azimuth position data, it is concluded that the interquartile range IQR (or some other lQR) dispersion statistic is a good discriminator between the head position distributions for the four visual environments. For all subjects, the IQR for the night vision goggle visual environment was larger than for the other three visual environments. Likewise, the IQR for good visual environment was always the second largest. The IQR values for thermal imaging only and rotary wing symbology, the most closely related visual environments, vie for third and fourth ranking.
DTIC
Helmet Mounted Displays; Rotary Wings; Head (Anatomy); Human Factors Engineering

20030068131 NASA Marshall Space Flight Center, Huntsville, AL, USA
Sabatier Engineering Development Unit
Perry, Jay; Smith, Fred; Murdoch, Karen; [2003]; 6 pp.; In English; 33rd International Conference on Environmental Systems, 7-10 Jul. 2003, Vancouver, BC, Canada
Report No.(s): SAE-2003-02-2496; Copyright; Avail: CASI; A02, Hardcopy

To facilitate life support system loop closure on board the International Space Station (ISS), the Node 3 Oxygen Generation System (OGS) rack contains a functional scar to accommodate a carbon dioxide reduction assembly (CRA). As part of the effort to better understand and define the functional scar, significant risk mitigation activities have been performed. To address integration risks, a CRA Engineering Development Unit (EDU) has been developed that is functionally equivalent to a flight CRA and is suitable for integrating with ground based carbon dioxide removal and oxygen generation systems. The CRA EDU has been designed to be functionally equivalent to the Sabatier Reactor Subsystem (SRS) portion of the CRA. The design of the CRA EDU and testing results in a stand alone configuration with simulated OGA and CDRA interfaces are reported. Carbon dioxide flow control is a major area requiring development since the size of the CO2 accumulator may result in periods of CRA starvation. The capability of the CO2 flow control algorithm to effectively manage integrated CRA operations is discussed.
Author
Carbon Dioxide Removal; Life Support Systems; Product Development

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EXOBIOLOGY

Includes astrobiology; planetary biology; and extraterrestrial life. For the biological effects of aerospace environments on humans see *52 Aerospace Medicine*; on animals and plants see *51 Life Sciences*. For psychological and behavioral effects of aerospace environments see *53 Behavioral Sciences*.

20030068031 Scripps Institution of Oceanography, San Diego, CA, USA
State-of-the-art Instruments for Detecting Extraterrestrial Life
Bada, Jeffrey L.; PNAS; January 2003; Volume 98, No. 3, pp. 797-800; In English
Contract(s)/Grant(s): NAG5-4546; Copyright; Avail: Other Sources

In the coming decades, state-of-the-art spacecraft-based instruments that can detect key components associated with life as we know it on Earth will directly search for extinct or extant extraterrestrial life in our solar system. Advances in our analytical and detection capabilities, especially those based on microscale technologies, will be important in enhancing the abilities of these instruments. Remote sensing investigations of the atmospheres of extrasolar planets could provide evidence of photosynthetic-based life outside our solar system, although less advanced life will remain undetectable by these methods. Finding evidence of extraterrestrial life would have profound consequences both with respect to our understanding of chemical and biological evolution, and whether the biochemistry on Earth is unique in the universe.
Author
Spacecraft Instruments; Remote Sensing; Extraterrestrial Life

20030068350 Scripps Institution of Oceanography, La Jolla, CA, USA
Micro-Detection System for Determination of the Biotic or Abiotic Origin of Amino Acids
Bada, Jeffrey L.; [2003]; 4 pp.; In English
Contract(s)/Grant(s): NAG5-9659; No Copyright; Avail: CASI; A01, Hardcopy

The research carried out under this PIDDP involves the development of a breadboard version of a spacecraft-based system for the detection of amino acid chirality (molecular handedness) on solar system bodies. Chirality provides an unambiguous way of distinguishing between abiotic and biotic origins since only one mirror-image form is used in the functional molecules of life. Recent advances in a variety of nano-fabrication technologies have resulted in concepts for enabling miniaturized chemical and biological analytical systems. These are complete application-specific systems that integrate fluid micro handling systems for extracting and reacting target molecules, micro-separation technologies for enhanced sensitivity and resolution, and advanced detection technologies. This effort makes use of a relatively new technology that shows demonstrated promise for spacecraft-based amino acid analysis: microchip-based capillary electrophoresis (muCE). The muCE system is capable of analyzing the type of amino acids present as well as the relative amounts of their mirror image forms. The system we developed will be able to chirally resolve all of the major amino acids found in extraterrestrial material (Gly, Ala, Val, Pro, Asp, Glu, a-aminoisobutyric acid, and isovaline) at sub-part-per-billion levels. The _CE analysis requires that the amino acids be extracted from the sample and derivatized for either optical or electrochemical detection. In our implementation, the amino acids are released from the sample by sublimation and prepared for muCE analysis using a microfluidic circuit. In addition,

we have investigated the use of a microfluidic circuit for the release of amino acids from samples in which sublimation has proven to be problematic.
Author
Amino Acids; Detection; Electrophoresis; Handedness; Miniaturization; Abiogenesis

59
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*.

20030067744 Newcastle-upon-Tyne Univ., Newcastle
Modelling Collaboration Trusted Multi-agency Environment
Aljareh, S.; Rossiter, N.; Feb. 2003; 22 pp.; In English
Report No.(s): PB2003-105171; CS-TR-764; Copyright; Avail: National Technical Information Service (NTIS)

Security problems in collaboration work are less well understood than those in the business and defense worlds. Earlier work in the medical area in Britain has highlighted some of the principles involved but has neglected some important areas. Most of the security models developed to date are inadequate in the collaboration area. The authors develop a perspective for policies and models that is task-based on a need-to-know basis. These policies can be represented at Petri nets to identify the functions and states involved. The authors have also developed a general architecture for a secure collaborative environment. An example is given of the application of the authors' techniques to a problem involving negotiation, decision and agreement in a collaboration environment.
NTIS
Computer Information Security; Architecture (Computers); Mathematical Models; Computer Networks

20030067748 Newcastle-upon-Tyne Univ., Newcastle
Goal-Diversity in the Design of Dependable Computer-Based Systems
Feb. 2003; 36 pp.; In English
Report No.(s): PB2003-105172; CS-TR-762; Copyright; Avail: National Technical Information Service (NTIS)

This paper sets out an argument for experimenting with some aspects of the 'Open-Source' development style in the creation of 'Computer-Based Systems'. The particular objective is to find ways of increasing the 'Dependability' of systems. The most interesting facet of Open Source development in this connection is the use of multiple developers to introduce diversity into the design process. In addition to relying on the fact that no two developers are identical, the suggestion here is that asking each developer to emphasize different goals might result in solutions whose comparison and combination could increase dependability.
NTIS
Computer Techniques; Computer Systems Programs; Open Source Licensing (Computers); Software Engineering

20030067752 Newcastle-upon-Tyne Univ., Newcastle
Technical and Human Issues in Computer-Based Systems Security
Arief, B.; Besnard, D.; Apr. 2003; 26 pp.; In English
Report No.(s): PB2003-105175; CS-TR-790; Copyright; Avail: National Technical Information Service (NTIS)

Computer systems and internet are becoming pervasive in our everyday life. Being online brings the consequence that such systems are prone to malicious attack. This vulnerability, along with our reliance on these systems, implies that it is important for us to do our best in securing them to ensure their proper functioning. In this paper, the authors are trying to tackle the security issues from both technical and human perspectives. From this dual standpoint, the authors hope to obtain a better understanding on how computer attacks are performed, including how to gain illicit access, the types of attacks, as well as the psychological traits of the attackers, including their community, taxonomy, motives and work ethics. This survey paper will not provide a concrete solution on how to secure computer systems, but it highlights the socio-technical approach that we must take in order to obtain that goal.
NTIS
Human Factors Engineering; Computer Information Security; Systems Engineering; Computer Systems Programs

20030067763 Newcastle-upon-Tyne Univ., Newcastle

Verifiable Fault-Tolerant Transformation of a Real-Time Legacy System

Owen, D. J.; Ezhilchelvan, P. D.; Apr. 2003; 30 pp.; In English

Report No.(s): PB2003-105178; CS-TR-785; Copyright; Avail: National Technical Information Service (NTIS)

Transforming a non-fault-tolerant legacy system into a fault-tolerant one requires, among other things, a convincing proof or argument that the transformed system is functionally equivalent. In addition, one should be able to assess whether the new system is capable of meeting the timeliness guarantees of the original system, since the fault-tolerance support activities typically impose a performance overhead. This paper describes the approach and methods we have adopted to transform an industrial-strength real-time system specified in a low level language called the real-time network specification language (RTN-SL). We have addressed two issues: (1) expressing the low-level design specification in a suitably abstract form that simplifies fault-tolerant transformations; and (2) formulation of rules for incorporating known fault-tolerant techniques in a machine verifiable manner. The former is achieved by the use of a context-sensitive graph grammar and the verification of transformation by utilizing the IFAD VDM-SL Toolbox. Our experience in applying these fault-tolerant transformations on an industrial-strength legacy system exposes a general problem encountered, merits of utilizing existing industrial tools and the kinds of tools that need to be developed.

NTIS

Fault Tolerance; Real Time Operation; Program Verification (Computers); Computer Networks

20030067784 Newcastle-upon-Tyne Univ., Newcastle

Designing Fault-Tolerant Mobile Systems

Serugendo, G. D. M.; Romanovsky, A.; Jan. 2003; 26 pp.

Report No.(s): PB2003-105188; CS-TR-783; Copyright; Avail: National Technical Information Service (NTIS)

The purpose of this paper is to investigate how several innovative techniques, not all initially intended for fault-tolerance, can be applied in providing fault tolerance of complex mobile agent systems. Due to their roaming nature, mobile agents usually run on Java-based platforms, which ensures full portability of mobile code. The first part of the paper discusses specific characteristics of mobile systems, outlines the application areas benefiting from code mobility, and shows why the existing error recovery techniques are not suitable for mobile systems. In the next part of the paper the authors present evaluation criteria for fault tolerance techniques, and propose several possible solutions for error recovery at the application level: meta-agent, Coordinated Atomic actions, asynchronous resolution, self-repair, and proof carrying code. The intention is to allow system developers to choose the approach which is suited best to the characteristics of the mobile agent application to be designed. To this end the authors discuss the advantages and disadvantages of each technique, as well as situations in which it provides the most benefit. A simple example, based on Internet shopping, is used throughout the paper to demonstrate the techniques.

NTIS

Complex Systems; Fault Tolerance; Mobile Communication Systems; Design Analysis

20030067786 Newcastle-upon-Tyne Univ., Newcastle

Analysis of the Oscillation Problem in Tri-Flops

Maevsky, O.; Kinniment, D. J.; Yakovlev, A.; Bystrov, A.; Sep. 2002; 20 pp.

Report No.(s): PB2003-105190; CS-TR-747; Copyright; Avail: National Technical Information Service (NTIS)

A tri-flop can be used to build fast three-way arbiters. It is known that this device may exhibit oscillatory behavior which is difficult to filter out. Using a small-signal dynamic model, this paper presents new conditions for avoiding oscillations that are more accurate than previously known. Some theoretical and practical limitations of these conditions are outlined.

NTIS

Dynamic Models; Oscillations; Architecture (Computers); Systems Engineering

20030067787 Newcastle-upon-Tyne Univ., Newcastle

Protective Wrapper Development: A Case Study

Anderson, T.; Feng, M.; Riddle, S.; Romanovsky, A.; Jan. 2003; 22 pp.

Report No.(s): PB2003-105201; CS-TR-781; Copyright; Avail: National Technical Information Service (NTIS)

We have recently proposed a general approach to engineering protective wrappers as a means of detecting errors or unwanted behavior in systems employing an OTS (Off-The-Shelf) item, and launching appropriate recovery actions. This paper presents results of a case study in protective wrapper development, using a SIMULINK model of a steam boiler system

together with an OTS PID (Proportional, Integral and Derivative) controller. The protective wrappers are developed for the model of the system in such a way that they allow detection and tolerance of typical errors caused by unavailability of signals, violations of constraints, and oscillations.
NTIS
Protectors; Error Detection Codes; Mathematical Models; Applications Programs (Computers)

20030067789 Newcastle-upon-Tyne Univ., Newcastle
Tool for Identifying State Coding Conflicts Using STG Unfoldings
Madalinski, A.; Bystrov, A.; Yakovlev, A.; Jan. 2003; 28 pp.
Report No.(s): PB2003-105205; CS-TR-773; Copyright; Avail: National Technical Information Service (NTIS)

State coding conflict detection is a fundamental part of the synthesis of asynchronous concurrent systems from their Signal Transition Graph (STG) specifications. This paper presents the extension of the method proposed earlier, the identification of state coding conflicts in STGs which is intended to work within a synthesis framework based on STG unfoldings. This approach has been implemented as a software tool using refined algorithms. A necessary condition detects state coding conflicts by using an approximate state covering approach. Being computationally efficient, this algorithm may generate false alarms. Thus a refinement technique is applied based on partial construction of the state space with extra computational cost. The experimental results demonstrating the efficiency of this approach are presented.
NTIS
Synchronism; Coding; Algorithms; Specifications; Software Development Tools

20030067793
Transforming Power of Information Technology
2003; 102 pp.
Report No.(s): PB2003-106129; No Copyright; Avail: CASI; A06, Hardcopy

Information Technology has the power to transform the functions of the federal government and to place the services of government at the fingertips of its citizens. To realize this goal, the federal government must be able to attract and retain the very best workforce to develop, implement, and manage a wide variety of information technology systems. And to be able to attract and retain the very best and most proficient workforce, the federal system for recruiting, retaining, compensating, and developing information technology employees must change. Recognizing the importance of this issue, the Chief Information Officers Council asked the Academy to initiate a study of alternative pay systems and related human resources management issues that might help the federal government attract and retain a skilled IT workforce. This study has identified a number of effective human resources management practices that can be used by the federal government to improve its competitive position in the war for talent.
NTIS
Information Systems; Governments; Technologies; Human Resources

20030067799 Lawrence Livermore National Lab., Livermore, CA
Distributed Data Integration Infrastructure
Crithlow, T.; Ludaescher, B.; Vouk, M.; Pu, C.; Feb. 24, 2003; 16 pp.; In English
Report No.(s): DE2003-15003342; UCRL-CR-151855; No Copyright; Avail: Department of Energy Information Bridge

The Internet is becoming the preferred method for disseminating scientific data from a variety of disciplines. This can result in information overload on the part of the scientists, who are unable to query all of the relevant sources, even if they knew where to find them, what they contained, how to interact with them, and how to interpret the results. To help address this problem, the report presents an end-user centric, domain sensitive workflow-based infrastructure, that will allow scientists to design complex scientific workflows that reflect the data manipulation required to perform their research without an undue burden.
NTIS
Data Integration; Information Dissemination

20030067801 Lawrence Livermore National Lab., Livermore, CA
Discrete Ordinates Algorithm for Radiation Transport Using Block-Structured Adaptive Mesh Refinement
Howell, L. H.; Feb. 03, 2003; In English
Report No.(s): DE2003-15003382; UCRL-JC-148857; No Copyright; Avail: National Technical Information Service (NTIS)

The discrete ordinates method is well-suited to implementation with block-structured adaptive mesh refinement (AMR). AMR meshes group points into logically-rectangular patches, and provide the benefits of adaptivity without sacrificing the efficiency and geometric regularity of regular grids. In particular, these meshes preserve the directional ordering of points required for explicit ordinate transport sweeps. A number of algorithmic issues must be addressed to make such a method practical. These include sequencing of ordinates and grids for parallel execution, simultaneous solution of the transport equation on multiple levels of the grid hierarchy, implicit coupling to the fluid energy, and conservation of energy in a time-dependent context where different grid levels advance with different timesteps. The report discusses these and other issues and present example calculations in two and three spatial dimensions.
NTIS
Radiation Transport; Incompressible Flow; Algorithms

20030067983 NASA Ames Research Center, Moffett Field, CA, USA
Dynamics of Quantum Adiabatic Evolution Algorithm for Number Partitioning
Smelyanskiy, V. N.; Toussaint, U. V.; Timucin, D. A.; February 19, 2002; 32 pp.; In English
Contract(s)/Grant(s): 749-40-00; Copyright; Avail: CASI; A03, Hardcopy

We have developed a general technique to study the dynamics of the quantum adiabatic evolution algorithm applied to random combinatorial optimization problems in the asymptotic limit of large problem size n. We use as an example the NP-complete Number Partitioning problem and map the algorithm dynamics to that of an auxiliary quantum spin glass system with the slowly varying Hamiltonian. We use a Green function method to obtain the adiabatic eigenstates and the minimum excitation gap. g min, = O(n 2(exp -n/2), corresponding to the exponential complexity of the algorithm for Number Partitioning. The key element of the analysis is the conditional energy distribution computed for the set of all spin configurations generated from a given (ancestor) configuration by simultaneous flipping of a fixed number of spins. For the problem in question this distribution is shown to depend on the ancestor spin configuration only via a certain parameter related to 'the energy of the configuration. As the result, the algorithm dynamics can be described in terms of one-dimensional quantum diffusion in the energy space. This effect provides a general limitation of a quantum adiabatic computation in random optimization problems. Analytical results are in agreement with the numerical simulation of the algorithm.
Author
Algorithms; Quantum Computation; Asymptotes; Dynamics; Number Theory; Partitions (Mathematics); Adiabatic Equations

20030068099 NASA Glenn Research Center, Cleveland, OH, USA
Concepts of Mathematics for Students of Physics and Engineering: A Dictionary
Kolecki, Joseph C.; August 2003; 50 pp.; In English
Contract(s)/Grant(s): WBS-22-755-60-04
Report No.(s): NASA/TP-2003-212088; E-13741; NAS 1.60:212088; No Copyright; Avail: CASI; A03, Hardcopy

A physicist with an engineering background, the author presents a mathematical dictionary containing material encountered over many years of study and professional work at NASA. This work is a compilation of the author's experience and progress in the field of study represented and consists of personal notes and observations that can be used by students in physics and engineering.
Author
Dictionaries; Physics; Education; Engineering; Mathematics

20030068329 Royal Inst. of Tech., Stockholm, Sweden
Uncertainty for the M. Riez Potentials
Beliaev, D. B.; Havin, V. P.; Dec. 1999; 24 pp.; In English
Report No.(s): PB2003-105153; TRITA-MAT/99-MA-24; No Copyright; Avail: CASI; A03, Hardcopy

This document discusses the uncertainty principle for the M. Riez potentials.
NTIS
Integrals; Potential Theory

20030068331 Royal Inst. of Tech., Stockholm, Sweden
Homogeneous Maximal Estimates for Solutions to the Schroedinger Equation
Sjoelin, P.; Apr. 2000; 14 pp.; In English
Report No.(s): PB2003-105152; TRITA-MAT-00-MA-11; No Copyright; Avail: CASI; A03, Hardcopy

Homogeneous maximal estimates are considered for solutions to an initial value problem for the Schrodinger equation. Also more general oscillatory integrals are studied.
NTIS
Schroedinger Equation; Estimating

20030068334 Royal Inst. of Tech., Stockholm, Sweden
Sidon Sequences Count
Linstroem, B.; Feb. 2000; 24 pp.; In English
Report No.(s): PB2003-105148; TRITA-MAT-00/MA-04; No Copyright; Avail: CASI; A03, Hardcopy

O. Moreno has proved the existence of primitive quadratics of trace 1 over GF(q). By applying the affine difference sets of Bose, we prove the upper bound psi(q+1)/2 for the number of Moreno quadratics. The difference sets of Bose have prime multiplier p when q=p(sup k). We discuss their orbit structure when p=2. Finally, we study a problem of erdos on the size of B2-sequences in finite intervals.
NTIS
Integers; Sequencing; Multipliers

20030068338 NASA Ames Research Center, Moffett Field, CA, USA
Density Estimation with Mercer Kernels
Macready, William G.; June 02, 2003; 8 pp.; In English; Neural Information Processing System Conference 2003, 9-11 Dec. 2003; Original contains black and white illustrations; No Copyright; Avail: CASI; A02, Hardcopy

We present a new method for density estimation based on Mercer kernels. The density estimate can be understood as the density induced on a data manifold by a mixture of Gaussians fit in a feature space. As is usual, the feature space and data manifold are defined with any suitable positive-definite kernel function. We modify the standard EM algorithm for mixtures of Gaussians to infer the parameters of the density. One benefit of the approach is it's conceptual simplicity, and uniform applicability over many different types of data. Preliminary results are presented for a number of simple problems.
Author
Algorithms; Kernel Functions; Methodology; Mathematical Models; Normal Density Functions

20030068363 Los Alamos National Lab., NM
Neural Network Based System for Damage Identification and Location in Structural and Mechanical Systems
Farrar, C. R.; Doebling, S. W.; Prime, M. B.; Cornwell, P.; Kam, M.; 1999; 16 pp.; In English
Report No.(s): DE2003-674673; LA-UR-98-2232; No Copyright; Avail: Department of Energy Information Bridge

This is the final report of a three-year, Laboratory Directed Research and Development (LDRD) project at the Los Alamos National Laboratory (LANL). Recent advances in wireless, remotely monitored data acquisition systems coupled with the development of vibration-based damage detection algorithms make the possibility of self- or remotely-monitored structures and mechanical systems appear to be within the capabilities of current technology. However, before such a system can be relied upon to perform this monitoring, the variability of the vibration properties that are the basis for the damage detection algorithm must be understood and quantified. This understanding is necessary so that the artificial intelligence/expert system that is employed to discriminate when changes in modal properties are indicative of damage will not yield false indications of damage. To this end, this project has focused on developing statistical methods for quantifying variability in identified vibration properties of structural and mechanical systems.
NTIS
Neural Nets; Statistical Analysis; System Identification

20030068365 New Mexico Univ., Albuquerque, NM, USA
Using Multiple Perspectives to Suppress Information and Complexity
Kelsey, R.; Webster, R.; Hartley, R.; 1999; 22 pp.; In English
Report No.(s): DE2003-674719; LA-UR-98-1065; No Copyright; Avail: Department of Energy Information Bridge

This paper presents a framework for suppressing information using an object-based knowledge representation methodology. This methodology has the ability to represent knowledge and information in multiple perspectives. Information can be suppressed by creating a perspective specific to an individual warfighter. In this way, only the information pertinent

and useful to a warfighter is made available to that warfighter. Information is not removed, lost, or changed, but spread among multiple perspectives.
NTIS
Information Dissemination; Knowledge Representation

20030068378 Newcastle-upon-Tyne Univ., Newcastle
Asynchronous Box Calculus
Devillers, R.; Klaudel, M.; Koutny, M.; Pommereau, F.; Sep. 2002; 52 pp.; In English
Report No.(s): PB2003-105191; CS-TR-759; Copyright; Avail: National Technical Information Service (NTIS)

The starting point of this paper is an algebraic Petri net framework allowing one to express net compositions, such as iteration and parallel composition, as well as transition synchronization and restriction. We enrich the original model by introducing new constructs supporting asynchronous interprocess communication. Such a communication is made possible thanks to special 'buffer' places where different transitions (processes) may deposit and remove tokens. We also provide an abstraction mechanism, which hides buffer places, effectively making them private to the processes communicating through them. We then provide a characterization of the operational step sequence semantics of composite nets. These developments lead to an algebra of process expressions, whose constants and operators directly correspond to those used in the Petri net framework. Such a correspondence is used to associate nets to process expressions in a fully compositional way. Moreover, a structural characterization of the Petri net semantics of composite nets guides the definition of a structured operational semantics of process expressions. That the resulting algebra of expressions is consistent with the net algebra is demonstrated by showing that an expression and the corresponding net generate isomorphic transition systems. This results in the Asynchronous Box Calculus (or ABC), which is a coherent dual model, based on Petri nets and process expressions, suitable for modeling and analyzing distributed systems whose components can interact using both synchronous and asynchronous communication.
NTIS
Calculus; Synchronism

20030068379 Newcastle-upon-Tyne Univ., Newcastle
Revised Version of DSoS Conceptual Model
Jones, C. B.; Killijian, M. O.; Kopetz, H.; Marsden, E.; Moffat, N.; Sep. 2002; 144 pp.
Report No.(s): PB2003-105215; CS-TR-746; Copyright; Avail: National Technical Information Service (NTIS)

The purpose of this deliverable is to present a revised version of the DSoS conceptual model, which was first presented in deliverable BC1. As part of the revision, we have attempted to generalize the model by identifying abstract concepts that are applicable to more than one kind of system of systems. We have also developed a taxonomy in order to explore the range of possible systems of systems, and the different factors that could impact the dependability of such compositions of systems. The deliverable starts by introducing a set of basic concepts including a model of time. It concludes by summarizing the contents of the deliverable and briefly discussing further work.
NTIS
Taxonomy; Delivery

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*.

20030068051 Air Force Inst. of Tech., Wright-Patterson AFB, OH, USA
Antecedents and Outcomes of End User Computing Competence
Case, David A.; Mar. 25, 2003; 140 pp.; In English
Report No.(s): AD-A415162; AFIT/GIR/ENV/03-01; No Copyright; Avail: CASI; A07, Hardcopy

The tremendous proliferation of end user computing (EUC) in the workplace over the past few decades is cause for concern in public and private organizations. Computer use has moved from individuals working with 'dumb' terminals in centralized networks to individuals operating personal computers, just as powerful as yesterday's mainframe. The end user has had to evolve and will continue evolving as well; from someone with low level technical skills to someone with a high level of technical knowledge and information managerial skills. Because EUC continues growing more sophisticated, end users

must not only maintain a level of competence, but prepare for the next generation of computing technology. Doing so will enable organizations to continue enjoying the positive benefits of EUC success. Research indicates that EUC success may depend on end user competence. Using Structural Equation Modeling (SEM) to test an integrated model of EUC success, the results of this study show that computer training, education level, beliefs about computer systems and the ability to operate them lead to end user computing competence. Additionally, results show that computer system use, a factor in achieving EUC success, is an outcome of end user computing competence. The overall conclusions drawn from this study is that the Air Force organization may be able to improve its efforts to successfully use computing technology, however it appears individual personnel have the competence to do so already. There may be additional underlying factors contributing to the lack of significant computing success, the discovery of which is a prospect for future research.
DTIC
Computers; Microcomputers; User Requirements; Computation

20030068939 Department of the Navy, Washington, DC
Multimode Invariant Processor
Woodall, Roger L., Inventor; Aug. 17, 2000; 40 pp.; In English
Patent Info.: Filed 17 Aug. 2000; US-Patent-Appl-SN-09641395
Report No.(s): AD-D020070; No Copyright; Avail: Other Sources

A multimode invariant processor is provided to simultaneously classify one or more patterns in multidimensional or in two dimensional real world images. The classification is invariant to a translation, a change in scale size and a rotation of a whole or partially hidden photonic image. The multimode invariant image processor comprises a retina portion a nonlinear processing portion a convergence processing portion and a classifier portion. The retina portion processes the photonic image to obtain an image data array of pixels and further process the array of pixels through a window difference network to obtain gradients of the image data. The neural directors of the nonlinear processing portion receive the gradients and generate respective feature vectors which may have a greater dimensionality than the gradient information, to aid in discrimination between similar patterns in the image data. The convergence portion processes the feature information to generate a convergence of common feature information representing at least one image feature in the image data. The classifier portion receives the common feature information and generates in response feature classification information indicating the likelihood that selected features are present in the image.
DTIC
Image Processing; Multimode Resonators

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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.

20030067708
Computer Modelling of Virtual Cathode Oscillators (Vircators)
Lindsay, P. A.; Chen, X.; Watkins, J.; Toh, W. K.; Feb. 28, 2003; 156 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): F49620-00-1-0157
Report No.(s): AD-A414678; AFRL-SR-AR-TR-03-0087; No Copyright; Avail: CASI; A08, Hardcopy

This final report covers the results of investigations extending over the period 15 Jan 2000 - 30 Nov 2002. The report consists of two parts, in Part 1 a computer model of a vircator developed at the Texas Technical University is developed using a powerful code called MAGIC. Part 1 ends with design proposals leading to an increase in power output of 52%. Part 2 is primarily concerned with the influence of an axial magnetic field on the performance of a coaxial vircator, including stability investigations.
DTIC
Computerized Simulation; Microwave Oscillators

20030067830 Naval Postgraduate School, Monterey, CA
An Architecture for the Semantic Processing of Natural Language Input to a Policy Workbench
Custy, E. J.; Mar. 2003; 107 pp.; In English; Original contains color illustrations
Report No.(s): AD-A414808; No Copyright; Avail: CASI; A06, Hardcopy

Formal methods hold significant potential for automating the development, refinement, and implementation of policy. For this potential to be realized, however, improved techniques are required for converting natural-language statements of policy into a computational form. In this paper we present and analyze an architecture for carrying out this conversion. The architecture employs semantic networks to represent both policy statements and objects in the domain of those statements. We present a case study which illustrates how a system based on this architecture could be developed. The case study consists of an analysis of natural language policy statements taken from a policy document for web sites at a university, and is carried out with support from a software tool we developed which converts text output from a natural language parser into a graphical form.
DTIC
Natural Language (Computers); Semantics

20030067836 NASA Marshall Space Flight Center, Huntsville, AL, USA
Utilization of Internet Protocol-Based Voice Systems in Remote Payload Operations
Chamberlain, jim; Bradford, Bob; Best, Susan; Nichols, Kelvin; [2002]; 31 pp.; In English; SpaceOps 2002, 9-19 Oct. 2002, Houston, TX, USA; No Copyright; Avail: CASI; A03, Hardcopy

Due to limited crew availability to support science and the large number of experiments to be operated simultaneously, telescience is key to a successful International Space Station (ISS) science program. Crew, operations personnel at NASA centers, and researchers at universities and companies around the world must work closely together to per orm scientific experiments on-board ISS. The deployment of reliable high-speed Internet Protocol (IP)-based networks promises to greatly enhance telescience capabilities. These networks are now being used to cost-effectively extend the reach of remote mission support systems. They reduce the need for dedicated leased lines and travel while improving distributed workgroup collaboration capabilities. NASA has initiated use of Voice over Internet Protocol (VoIP) to supplement the existing mission voice communications system used by researchers at their remote sites. The Internet Voice Distribution System (IVoDS) connects remote researchers to mission support 'loopsll or conferences via NASA networks and Internet 2. Researchers use NODS software on personal computers to talk with operations personnel at NASA centers. IVoDS also has the ;capability, if authorized, to allow researchers to communicate with the ISS crew during experiment operations. NODS was developed by Marshall Space Flight Center with contractors & Technology, First Virtual Communications, Lockheed-Martin, and VoIP Group. NODS is currently undergoing field-testing with full deployment for up to 50 simultaneous users expected in 2002. Research is being performed in parallel with IVoDS deployment for a next-generation system to qualitatively enhance communications among ISS operations personnel. In addition to the current voice capability, video and data/application-sharing capabilities are being investigated. IVoDS technology is also being considered for mission support systems for programs such as Space Launch Initiative and Homeland Defense.
Author
Technology Utilization; Internets; Voice Communication; Payloads; Remote Control; Communication Networks

20030067917 NASA Ames Research Center, Moffett Field, CA, USA, Computer Sciences Corp., USA
Evaluation of Cache-based Superscalar and Cacheless Vector Architectures for Scientific Computations
Oliker, Leonid; Carter, Jonathan; Shalf, John; Skinner, David; Ethier, Stephane; Biswas, Rupak; Djomehri, Jahed; VanderWijngaart, Rob; May 2, 2003; 6 pp.; In English; Supercomputing 2003, 15-21 Nov. 2003, Phoenix, AZ, USA
Contract(s)/Grant(s): DTTS59-99-D-00437; NASA Order A-61812-D; Copyright; Avail: CASI; A02, Hardcopy

The growing gap between sustained and peak performance for scientific applications has become a well-known problem in high performance computing. The recent development of parallel vector systems offers the potential to bridge this gap for a significant number of computational science codes and deliver a substantial increase in computing capabilities. This paper examines the intranode performance of the NEC SX6 vector processor and the cache-based IBM Power3/4 superscalar architectures across a number of key scientific computing areas. First, we present the performance of a microbenchmark suite that examines a full spectrum of low-level machine characteristics. Next, we study the behavior of the NAS Parallel Benchmarks using some simple optimizations. Finally, we evaluate the perfor- mance of several numerical codes from key scientific computing domains. Overall results demonstrate that the SX6 achieves high performance on a large fraction of our application suite and in many cases significantly outperforms the RISC-based architectures. However, certain classes of applications are not easily amenable to vectorization and would likely require extensive reengineering of both algorithm and implementation to utilize the SX6 effectively.
Author
Vector Processing (Computers); Parallel Processing (Computers)

20030067960 NASA Marshall Space Flight Center, Huntsville, AL, USA

Lessons Learned in Developing Multiple Distributed Planning Systems for the International Space Station

Maxwell, Theresa G.; [2002]; 28 pp.; In English; SpaceOps 2002 Conference, 9-12 Oct. 2002, Houston, TX, USA; No Copyright; Avail: CASI; A03, Hardcopy

The planning processes for the International Space Station (ISS) Program are quite complex. Detailed mission planning for ISS on-orbit operations is a distributed function. Pieces of the on-orbit plan are developed by multiple planning organizations, located around the world, based on their respective expertise and responsibilities. The pieces are then integrated to yield the final detailed plan that will be executed onboard the ISS. Previous space programs have not distributed the planning and scheduling functions to this extent. Major ISS planning organizations are currently located in the USA (at both the NASA Johnson Space Center (JSC) and NASA Marshall Space Flight Center (MSFC)), in Russia, in Europe, and in Japan. Software systems have been developed by each of these planning organizations to support their assigned planning and scheduling functions. Although there is some cooperative development and sharing of key software components, each planning system has been tailored to meet the unique requirements and operational environment of the facility in which it operates. However, all the systems must operate in a coordinated fashion in order to effectively and efficiently produce a single integrated plan of ISS operations, in accordance with the established planning processes. This paper addresses lessons learned during the development of these multiple distributed planning systems, from the perspective of the developer of one of the software systems. The lessons focus on the coordination required to allow the multiple systems to operate together, rather than on the problems associated with the development of any particular system. Included in the paper is a discussion of typical problems faced during the development and coordination process, such as incompatible development schedules, difficulties in defining system interfaces, technical coordination and funding for shared tools, continually evolving planning concepts/ requirements, programmatic and budget issues, and external influences. Techniques that mitigated some of these problems will also be addressed, along with recommendations for any future programs involving the development of multiple planning and scheduling systems. Many of these lessons learned are not unique to the area of planning and scheduling systems, so may be applied to other distributed ground systems that must operate in concert to successfully support space mission operations. Author

Mission Planning; Computer Systems Programs; Software Engineering; Space Missions; Space Programs; International Space Station

20030067985 Naval Postgraduate School, Monterey, CA

Exploring of Wireless Technology to Provide Information Sharing Among Military, United Nations and Civilian Organizations During Complex Humanitarian Emergencies and Peacekeeping Operations

Bridges, Douglas M., Jr.; Mason, Adonis R.; Mar. 2003; 89 pp.; In English; Original contains color illustrations

Report No.(s): AD-A414852; No Copyright; Avail: CASI; A05, Hardcopy

Natural as well as man-made disasters have become commonalities of daily life in recent decades for a large portion of the world's population. This growing trend reflects the worldwide proliferation in recent years of Complex Humanitarian Emergencies (CHEs) and peacekeeping operations. Humanitarian emergencies and peacekeeping operations are a complex mix of related activities that require the combined efforts of the UN, military, International Organizations (IOs) and Non-Governmental Organizations (NGOs). Given the nature and similarities of their missions, there is an ongoing need for these organizations to have access to accurate, current, and comprehensive information about field conditions and each other's movements. In several of the CHEs and peacekeeping operations of recent years, a recurring problem has been poor communication due to inadequate equipment, non-compatibility of equipment and a non- standardized communications infrastructure. This thesis explores the impact and possible benefits that wireless technology can provide to help bridge the communication gap that exists among the UN and the NGOs who participate in CHEs and peacekeeping operations. DTIC

Information Transfer; Communication Networks; Telecommunication

20030067995 Carnegie-Mellon Univ., Pittsburgh, PA

Application of Options Analysis for ReengineeringSM (OARSM) in a Lead System Integrator (LSI) Environment

Bergey, John; O'Brien, Liam; Smith, Dennis; Mar. 2003; 30 pp.; In English

Report No.(s): AD-A414868; CMU/SEI-2003-TN-009; No Copyright; Avail: CASI; A03, Hardcopy

Since most organizations have a substantial legacy base of existing software assets, few development efforts start from scratch. However, there has not been a systematic way to identity components for reuse or to understand the types of changes that would be required for insertion into a product line architecture or a new software architecture. Options Analysis for ReengineeringSM (OARSM) is an approach for making decisions on mining software assets. Mining involves rehabilitating

parts of an old system for use in a new system. OAR identifies potential reusable components and analyzes the changes that would be needed to rehabilitate them for reuse within a software product line or new software architecture. OAR also provides an analysis of mining options, as well as the cost, effort, level of difficulty, and risks associated with each option. Recently, OAR has been applied to help a lead system integrator (LSI) make effective decisions on reuse. An LSI is the agent for an organization that is responsible for acquiring a large software-intensive system or system of systems. This note describes the use of OAR to guide decision making on mining assets within an LSI context, referred to as LSI OAR.
DTIC
Software Engineering; Integrators; Large Scale Integration

20030068000 ARIZONA STATE UNIV TEMPE DEPT. OF ELECTRICAL ENGINEERING, Tempe, AZ, USA
Attentive Sensing
Morrell, Darryl; Nov. 2002; 22 pp.; In English
Contract(s)/Grant(s): F49620-00-1-0124
Report No.(s): AD-A414862; TRC-DM-0301; AFRL-SR-AR-TR-03-0194; No Copyright; Avail: CASI; A03, Hardcopy

This report is the final progress report for a project whose goal is to examine a class of problems related to the effective allocation of sensing resources in situations involving tunable sensors, configurable sensor suites, or constraints in communication bandwidth and processing resources. We characterized the performance of optimal and suboptimal sensor allocation strategies for target location and detection problems. We have also implemented and characterized the performance of a target tracking algorithm that uses a configurable foveal sensor.
DTIC
Detection; Target Acquisition; Algorithms

20030068014 Naval Postgraduate School, Monterey, CA
Conceptual Framework Approach for System-of-Systems Software Developments
Caffall, Dale S.; Mar. 2003; 99 pp.; In English; Original contains color illustrations
Report No.(s): AD-A414822; No Copyright; Avail: CASI; A05, Hardcopy

The Department of Defense looks increasingly towards an interoperable and integrated system-of-systems to provide required military capability. Non-essential software complexity of a system-of-systems can have a greater negative impact in system behavior than a single system. Our current systems-of-systems tend to require a great deal of software maintenance and to be intolerant of even the most minor of changes with respect to negative perturbations in system behavior. In this thesis, we explore the benefits of developing a conceptual framework as the basis for the system-of-systems development. We examine the application of accepted software engineering practices for single-system developments to the more complex problem of system-of-systems development. Using the Ballistic Missile Defense System as a case study, we present an abstract framework from which we can reason about the system-of-systems. We develop a conceptual software architecture that represents a logical organization of proposed software modules. We map the functionality of the system to conceptual software components with coordination and data exchanges handled by conceptual connectors. Finally, we assess our work to determine the feasibility of applying the conceptual framework techniques described in this thesis to system-of-systems acquisitions with the objective of reducing accidental complexity and controlling essential complexity.
DTIC
Complex Systems; Computer Systems Programs; Software Engineering; Antimissile Missiles; Architecture (Computers)

20030068021 Naval Postgraduate School, Monterey, CA
Redefining Attack: Taking the Offensive Against Networks
Staples, Zachary H.; Michael, Robert J., II; Mar. 2003; 167 pp.; In English; Original contains color illustrations
Report No.(s): AD-A415027; No Copyright; Avail: CASI; A08, Hardcopy

The Information Age empowers individuals, and affords small groups an opportunity to attack states' interests with an increasing variety of tactics and great anonymity. Current strategies to prevail against these emerging threats are inherently defensive, relying on potential adversaries to commit mistakes and engage in detectable behavior. While defensive strategies are a critical component of a complete solution set, they cede initiative to the adversary. Moreover, reactive measures are not suited to quickly suppress adversary networks through force. To address this shortfall in strategic planning, the science of networks is rapidly making clear that natural systems built over time with preferential attachment form scale-free networks. These networks are naturally resilient to failure and random attack, but carry inherent vulnerabilities in their highly connected hubs. Taking the offensive against networks is therefore an exercise in discovering and attacking such hubs. To find these hub

vulnerabilities in network adversaries, this thesis proposes a strategy called Stimulus Based Discovery, which leads to rapid network mapping and then systematically improves the accuracy and validity of this map while simultaneously degrading an adversary's network cohesion. Additionally, this thesis provides a model for experimenting with Stimulus Based Discovery in a Multi-Agent System.
DTIC
Strategy; Armed Forces; Military Operations; Age Factor; Management Planning; Physical Exercise

20030068034 NASA Marshall Space Flight Center, Huntsville, AL, USA
Automated Coronal Loop Identification Using Digital Image Processing Techniques
Lee, Jong K.; Gary, G. Allen; Newman, Timothy S.; [2003]; 1 pp.; In English; Annual Meeting of the Solar Physics Div./American Astronomical Society, 16-20 Jun. 2003, Laurel, MD, USA; Copyright; Avail: Other Sources; Abstract Only

The results of a master thesis project on a study of computer algorithms for automatic identification of optical-thin, 3-dimensional solar coronal loop centers from extreme ultraviolet and X-ray 2-dimensional images will be presented. These center splines are proxies of associated magnetic field lines. The project is pattern recognition problems in which there are no unique shapes or edges and in which photon and detector noise heavily influence the images. The study explores extraction techniques using: (1) linear feature recognition of local patterns (related to the inertia-tensor concept), (2) parametric space via the Hough transform, and (3) topological adaptive contours (snakes) that constrains curvature and continuity as possible candidates for digital loop detection schemes. We have developed synthesized images for the coronal loops to test the various loop identification algorithms. Since the topology of these solar features is dominated by the magnetic field structure, a first-order magnetic field approximation using multiple dipoles provides a priori information in the identification process. Results from both synthesized and solar images will be presented.
Author
Algorithms; Solar Corona; Three Dimensional Models; Computer Programs

20030068078 NASA Glenn Research Center, Cleveland, OH, USA
Combustor Simulation
Norris, Andrew; 2002 Computing and Interdisciplinary Systems Office Review and Planning Meeting; August 2003, pp. 89-99; In English; See also 20030068074; Original contains color and black and white illustrations; No Copyright; Avail: CASI; A03, Hardcopy

The goal was to perform 3D simulation of GE90 combustor, as part of full turbofan engine simulation. Requirements of high fidelity as well as fast turn-around time require massively parallel code. National Combustion Code (NCC) was chosen for this task as supports up to 999 processors and includes state-of-the-art combustion models. Also required is ability to take inlet conditions from compressor code and give exit conditions to turbine code.
Derived from text
Combustion Chambers; Combustion Physics; Parallel Processing (Computers); Simulation; Turbofan Engines

20030068082 NASA Glenn Research Center, Cleveland, OH, USA
Information Environments
Follen, Gregory J.; Naiman, Cynthia; 2002 Computing and Interdisciplinary Systems Office Review and Planning Meeting; August 2003, pp. 23-41; In English; See also 20030068074; Original contains color illustrations; No Copyright; Avail: CASI; A03, Hardcopy

The objective of GRC CNIS/IE work is to build a plug-n-play infrastructure that provides the Grand Challenge Applications with a suite of tools for coupling codes together, numerical zooming between fidelity of codes and gaining deployment of these simulations onto the Information Power Grid. The GRC CNIS/IE work will streamline and improve this process by providing tighter integration of various tools through the use of object oriented design of component models and data objects and through the use of CORBA (Common Object Request Broker Architecture).
Derived from text
Software Development Tools; Computer Programs; Computerized Simulation

20030068086 NASA Glenn Research Center, Cleveland, OH, USA
NPSS Space Team
Lavelle, Tom; 2002 Computing and Interdisciplinary Systems Office Review and Planning Meeting; August 2003, pp. 101-113; In English; See also 20030068074; Original contains color illustrations; No Copyright; Avail: CASI; A03, Hardcopy

The objective is to increase the usability of the current NPSS code/architecture by incorporating an advanced space transportation propulsion system capability into the existing NPSS code and begin defining advanced capabilities for NPSS and provide an enhancement for the NPSS code/architecture.
Derived from text
Augmentation; Propulsion; Space Transportation System

20030068087 NASA Glenn Research Center, Cleveland, OH, USA
Cost Effective Testbeds and Code Parallelization Efforts
Lopez, Isaac; 2002 Computing and Interdisciplinary Systems Office Review and Planning Meeting; August 2003, pp. 141-148; In English; See also 20030068074; Original contains color illustrations; No Copyright; Avail: CASI; A02, Hardcopy

The objective is to develop in cooperation with other NASA centers a distributed computational environment capable of executing full 3-D aerospace propulsion applications.
Derived from text
Spacecraft Propulsion; Cost Effectiveness; Computational Grids

20030068088 NASA Glenn Research Center, Cleveland, OH, USA
A Lattice Boltzmann Method for Turbomachinery Simulations
Hsu, A. T.; Lopez, I.; 2002 Computing and Interdisciplinary Systems Office Review and Planning Meeting; August 2003, pp. 149-176; In English; See also 20030068074; Original contains color illustrations; No Copyright; Avail: CASI; A03, Hardcopy

Lattice Boltzmann (LB) Method is a relatively new method for flow simulations. The start point of LB method is statistic mechanics and Boltzmann equation. The LB method tries to set up its model at molecular scale and simulate the flow at macroscopic scale. LBM has been applied to mostly incompressible flows and simple geometry.
Derived from text
Boltzmann Transport Equation; Turbomachinery; Simulation

20030068165 Massachusetts Inst. of Tech., Cambridge, MA, USA
Software Tools to Support Research on Airport Departure Planning
Carr, Francis; Evans, Antony; Feron, Eric; Clarke, John-Paul; [2003]; 8 pp.; In English; 21st Digital Avionics Systems Conference, October 2002, Irvine, CA, USA
Contract(s)/Grant(s): NCC2-1147; MIT-OSP-6890296
Report No.(s): IEEE-02CH37325C; No Copyright; Avail: CASI; A02, Hardcopy

A simple, portable and useful collection of software tools has been developed for the analysis of airport surface traffic. The tools are based on a flexible and robust traffic-flow model, and include calibration, validation and simulation functionality for this model. Several different interfaces have been developed to help promote usage of these tools, including a portable Matlab(TM) implementation of the basic algorithms; a web-based interface which provides online access to automated analyses of airport traffic based on a database of real-world operations data which covers over 250 U.S. airports over a 5-year period; and an interactive simulation-based tool currently in use as part of a college-level educational module. More advanced applications for airport departure traffic include taxi-time prediction and evaluation of 'windowing' congestion control.
Author
Air Traffic; Airport Planning; Computer Programs; Data Bases

20030068231 Alabama Univ., Huntsville, AL, USA
ESML for Earth Science Data Sets and Analysis
Graves, Sara; Ramachandran, Rahul; [2003]; 4 pp.; In English
Contract(s)/Grant(s): NAG5-10407; No Copyright; Avail: CASI; A01, Hardcopy

The primary objective of this research project was to transition ESML from design to application. The resulting schema and prototype software will foster community acceptance for the Define once, use anywhere concept central to ESML. Supporting goals include: 1) Refinement of the ESML schema and software libraries in cooperation with the user community; 2) Application of the ESML schema and software to a variety of Earth science data sets and analysis tools; 3) Development of supporting prototype software for enhanced ease of use; 4) Cooperation with standards bodies in order to assure ESML is

aligned with related metadata standards as appropriate; and 5) Widespread publication of the ESML approach, schema, and software.
Derived from text
Earth Sciences; Research Projects; Software Engineering; Data Processing

20030068900 Defence Science and Technology Organisation, Edinburgh, Australia
A MATLAB Toolbox for Surveillance Operations Analysis
Hew, Patrick Chisan; May 2003; 42 pp.; In English; Original contains color illustrations
Report No.(s): DSTO-TN-0458; DODA-AR-012-470; Copyright; Avail: Other Sources

The MATLAB Surveillance Operations Analysis Toolbox Ver1.0.0 was developed to support operations analysis activities at DSTO. Built on MATLAB and the MATLAB Mapping Toolbox, the Toolbox embeds flexible and lightweight services for the analysis of surveillance operations. This document describes the capabilities, theory, design and use of the Toolbox, with the software being provided on the attached CD-ROM.
Author
Surveillance; Operations Research; Computer Programs

20030068907 Instituto Nacional de Tecnica Aeroespacial, Torrejon de Ardoz, Spain
Sensitivity of High Lift Behavior of a Supersonic Civil Transport to the Geometry of Lateral Gaps
Varona, Jose Jimenez; [2002]; 29 pp.; In English
Report No.(s): AT/TNO/4410/010/INTA/02; Copyright; Avail: Other Sources

This report is a brief handbook of the code OPTWIN, based on constraint optimum design methods. A sample case is included.
Author
Computerized Simulation; Computer Programs; Supersonic Transports; Lift

20030068942 Instituto Nacional de Pesquisas Espacias, Sao Jose dos Campos, Brazil
Design of Map Algebra Interface for Geoprocessing at SPRING Environment
SoaresdeLucena, Ivan; 2002; In Portuguese; CD-ROM contains full text document in PDF format
Report No.(s): INPE-9307-TDI/820; Copyright; Avail: CASI; C01, CD-ROM

Most implementations of Geographical Information Systems (GIS) include procedures, which allow the user to express complex spatial analysis models. These procedures are refereed to as Map Algebra, and are usually expressed by a language, which provides operations that generate new maps from an existing ones. The GIS system developed by National Institute of Space Research (INPE), includes the a spatial algebra language, whose use requires notions of programming languages. Such knowledge is not always available in the GIS user community. As an alternative to direct programming using this programming language, we have developed a friendly user interface for expressing Map Algebra programs, called (AMO) that means Map Algebra with Objects. AMO uses the flow diagram paradigm, which is a natural way of expressing spatial analysis problems, and enables the automatic generation of Map Algebra programs. In order to develop AMO, we have analyzed different alternatives for Map Algebra interfaces, including programming languages, forms and flow diagrams. AMO is an improvement of INPE's GIS technology, as it allows non-expert users a straightforward way of expressing complex spatial analysis problem. Finally, the AMO design has been based on general principles of GIS, and the interface can be extended for use with other systems.
Author
Geographic Information Systems; Programming Languages; Human-Computer Interface; Algebra

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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.

20030067973 Naval Postgraduate School, Monterey, CA
Determine Network Survivability Using Heuristic Models
Chua, Eng H.; Mar. 2003; 115 pp.; In English; Original contains color illustrations
Report No.(s): AD-A414845; No Copyright; Avail: CASI; A06, Hardcopy

Contemporary large-scale networked systems have improved the efficiency and effectiveness of our way of life. However, such benefit is accompanied by elevated risks of intrusion and compromises. Incorporating survivability capabilities into systems is one of the ways to mitigate these risks. The Server Agent-based Active network Management (SAAM) project was initiated as part of the next generation Internet project to address the increasing multi-media Internet service demands. Its objective is to provide a consistent and dedicated quality of service to the users. SAAM monitors the network traffic conditions in a region and responds to routing requests from the routers in that region with optimal routes. Mobility has been incorporated to SAAM server to prevent a single point of failure from bringing down the entire SAAM server and its service. With mobility, it is very important to select a good SAAM server locality from the client's point of view. The choice of the server must be a node where connection to the client is most survivable. In order to do that, a general metric is defined to measure the connection survivability of each of the potential server hosts. However, due to the complexity of the network, the computation of the metric becomes very complex too. This thesis develops heuristic solutions of polynomial complexity to find the hosting server node. In doing so, it minimizes the time and computer power required.
DTIC
Computer Programs; Computer Networks; Heuristic Methods

20030067977 Naval Postgraduate School, Monterey, CA
An Evaluation of Best Effort Traffic Management of Server and Agent-Based Active Network Management (SAAM) Architecture
Ayvat, Birol; Mar. 2003; 105 pp.; In English; Original contains color illustrations
Report No.(s): AD-A414849; No Copyright; Avail: CASI; A06, Hardcopy

The Server and Agent-based Active Network Management (SAAM) architecture was initially designed to work with the next generation Internet where increasingly sophisticated applications will require QoS guarantees. Although such QoS traffic is growing in volume, Best Effort traffic, which does not require QoS guarantees, needs to be supported for foreseeable future. Thus, SAAM must handle Best Effort traffic as well as QoS traffic. A Best Effort traffic management algorithm was developed for SAAM recently to take advantage of the abilities of the SAAM server. However, this algorithm has not been evaluated quantitatively. This thesis conducts experiments to compare the performance of the Best Effort traffic management scheme of the SAAM architecture against the well known MPLS Adaptive Traffic Engineering (MATE) Algorithm A couple of realistic network topologies were used. The results show while SAAM may not perform as well as MATE with a fixed set of paths, using SAAM's dynamic path deployment functionality allows the load to be distributed across more parts of the network, thus achieving better performance than MATE. Much of the effort was spent on implementing the MATE algorithm in SAAM. Some modifications were also made to the SAAM code based on the experimental results to increase the performance of SAAM's Best Effort solution.
DTIC
Computer Programs; Architecture (Computers); Computer Networks; Deployment; Algorithms

20030067992 Carnegie-Mellon Univ., Pittsburgh, PA
Trustworthy Refinement Through Intrusion-Aware Design (TRIAD)
Ellison, Robert J.; Moore, Andrew P.; Mar. 2003; 96 pp.; In English
Contract(s)/Grant(s): F19628-00-C-0003
Report No.(s): AD-A414865; CMU/SEI-2003-TR-002; ESC-TR-2003-002; No Copyright; Avail: CASI; A05, Hardcopy

High confidence in a system's survivability requires an accurate understanding of the system's threat environment and the impact of that environment on system operations. Unfortunately, existing development methods for secure and survivable information systems often employ a patchwork approach in which the focus is on deciding which popular security components to integrate rather than making a rational assessment of how to address the attacks that are likely to compromise the overall mission. This report proposes an intrusion-aware design model called trustworthy refinement through intrusion-aware design (TRIAD). TRIAD helps information system decision makers formulate and maintain a coherent, justifiable, and affordable survivability strategy that addresses mission-compromising threats for their organization. TRIAD also helps in evaluating and maintaining an information system design in terms of its ability to implement a survivability strategy. This report demonstrates the application of TRIAD to the refinement of a survivability strategy for a business that sells products over the Internet. TRIAD provides a solid foundation for the further refinement, experimentation, and validation of an approach to exploit knowledge of intruder behavior to improve system architecture design and operations. Ultimately, with effective tool support and evidence of its efficacy, TRIAD will be integrated with more comprehensive life-cycle models for the development and maintenance of high-confidence systems.
DTIC
Intrusion; Systems Engineering; Architecture (Computers)

20030068001 Naval Postgraduate School, Monterey, CA

A Framework for Maximizing the Survivability of Network Dependent Services

Aktop, Baris; Mar. 2003; 147 pp.; In English; Original contains color illustrations

Report No.(s): AD-A414883; No Copyright; Avail: CASI; A07, Hardcopy

As a consequence of the developments in information technology and the Internet, the world is getting increasingly dependent upon distributed systems and network services. Unfortunately, the security of these services has not kept pace with the advances in information technology itself. Security practitioners accept that, a system that is connected to an unbounded network, e.g., the Internet, will be vulnerable to attacks regardless of its security features. However, the emerging discipline of survivability can help ensure that such systems deliver essential services and maintain essential properties, such as integrity, confidentiality and performance, despite the presence of intrusions.

DTIC

Computer Networks; Information Systems; Intrusion

20030068019 Naval Postgraduate School, Monterey, CA

SNMP Over Wi-Fi Wireless Networks

Kerdsri, Jiradett; Mar. 2003; 108 pp.; In English; Original contains color illustrations

Report No.(s): AD-A415074; No Copyright; Avail: CASI; A06, Hardcopy

Simple Network Management Protocol (SNMP) allows users of network equipment (i.e. Network Administrators) to remotely query the state of any device being tested for system load utilization and configuration. Windows NT Windows 2000 and Windows XP Processional are all equipped with SNMP service so that an SNMP manager can communicate with an SNMP agent running on a wireless 802.11b client. However the rest of Windows operating systems including Windows CE and a Pocket PC have to run third party proxy SNMP agents in order to be recognized by an SNMP management application. This thesis describes an implementation of a Pocket PC SNMP agent for two Pocket PC mobile devices accessing a wired network via an 802. 11b wireless link. As a result of the implementation performed in this thesis an SNMP manager can wirelessly communicate with a Pocket PC client. However other results found that only some of the commercially available SNMP managers are able to access the mobile SNMP client and its management information base due to incompatible implementations of the server and client software.

DTIC

Client Server Systems; Wireless Communication; Networks; Data Management

20030068065 Naval Postgraduate School, Monterey, CA

Engineering Software for Interoperability through Use of Enterprise Architecture Techniques

Parenti, Jennifer L.; Mar. 2003; 101 pp.; In English; Original contains color illustrations

Report No.(s): AD-A415143; No Copyright; Avail: CASI; A06, Hardcopy

There are many efforts underway that are focused on resolving the system and software interoperability problems within the Department of Defense (DoD). While several of these efforts are attempting to attack this issue using new technologies and standardization, experience suggests most of these interoperability problems are caused by deficiencies in the way interoperability requirements are defined and captured within DoD's acquisition processes and policies. To affect real progress towards department-wide interoperability, it will be necessary to change the methods by which interoperability is considered in the acquisition process. This thesis proposes a new structured methodology for incorporating the use of enterprise architecture techniques into the DoD software acquisition process to provide a means by which interoperability requirements can be captured, defined, and levied at the appropriate time in a system's development. It discusses the necessary components of these architectural models, how these models capture DoD's interoperability needs, and how these interoperability needs form the basis for meaningful dialogue between the DoD's acquisition and planning communities. While this methodology is applicable to many domains and functional areas, for the purposes of this thesis, the focus will be solely on software systems (including systems with embedded software) within the DoD. (29 tables, 15 figures, 17 refs.)

DTIC

Software Engineering; Interoperability; Computer Programs

20030068076 General Electric Aircraft Engines, Cincinnati, OH, USA

Zooming from NPSS Cycle to Intermediate and High Fidelity

Plybon, Ron; 2002 Computing and Interdisciplinary Systems Office Review and Planning Meeting; August 2003, pp. 53-62; In English; See also 20030068074; Original contains color and black and white illustrations; No Copyright; Avail: CASI; A02, Hardcopy

The goals are: 1) Leverage NPSS, UEET and Other Engine Technology Efforts to Develop a High Fidelity Simulation Capability That Supports the UEET Vision; 2) Reduce Engine Development Time Through High Fidelity System Analysis at Early TRL; 3) Address System Issues While Configuration Changes Are Still Possible; 4) Achieve TRL 6 System Uncertainty at TRL 4; 5) Reduce Uncertainty in System Performance From Integration of UEET Component Technologies; and 6)Improved System Performance By Optimizing Configuration and System Design With Reduced Uncertainty on Component Performance and System Constraints.
Derived from text
Component Reliability; Engine Design; Systems Analysis; Systems Engineering

20030068083
NPSS With Nested Solvers For Zooming
Sirica, Steve; 2002 Computing and Interdisciplinary Systems Office Review and Planning Meeting; August 2003, pp. 43-52; In English; See also 20030068074; Original contains color illustrations; No Copyright; Avail: CASI; A02, Hardcopy

NPSS design provides system flexibility through a Nested Solver Implementation/Usage. Usage is expanding beyond original design intent by inner/outer loops. Potential follow on work includes: 1) Nested Solver Execution in Transient Mode; 2) Use of Inner Sub Assembly as Outer Solver; 3) Local Optimization vs. Nested Solver Approach; 4) Integration of Response Surfaces in place of Higher Fidelity Codes; 5) Develop High Fidelity Plug In Modules for NPSS; and 6) Ability to DLM Assemblies (potential speed issue?)
Derived from text
Computer Programs; Modules; Loops; Design Analysis

20030068524 Defence Science and Technology Organisation, Edinburgh, Australia
A Survey of Techniques for Security Architecture Analysis
Lawlor, Brendan; Vu, Linh; May 2003; 69 pp.; In English
Report No.(s): DSTO-TR-1438; DODA-AR-012-778; Copyright; Avail: Other Sources

This technical report is a survey of existing techniques which could potentially be used in the analysis of security architectures. The report has been structured to section the analysis process over three phases: the capture of a specific architecture in a suitable representation, discovering attacks on the captured architecture, and then assessing and comparing different security architectures. Each technique presented in this report has been recognized as being potentially useful for one phase of the analysis. By presenting a set of potentially useful techniques, it is hoped that designers and decision-makers involved in the development and maintenance of security architectures will be able to develop a more complete, ustified and usable methodology other than those currently being used to perform analyses.
Author
Computer Information Security; Computer Networks; Architecture (Computers); Systems Analysis

20030068914 NASA Ames Research Center, Moffett Field, CA, USA
Automating CPM-GOMS
John, Bonnie; Vera, Alonso; Matessa, Michael; Freed, Michael; Remington, Roger; 2002; Volume 4, No. 1; 4 pp.; In English
Contract(s)/Grant(s): NAG2-1472; Copyright; Avail: CASI; A01, Hardcopy

CPM-GOMS is a modeling method that combines the task decomposition of a GOMS analysis with a model of human resource usage at the level of cognitive, perceptual, and motor operations. CPM-GOMS models have made accurate predictions about skilled user behavior in routine tasks, but developing such models is tedious and error-prone. We describe a process for automatically generating CPM-GOMS models from a hierarchical task decomposition expressed in a cognitive modeling tool called Apex. Resource scheduling in Apex automates the difficult task of interleaving the cognitive, perceptual, and motor resources underlying common task operators (e.g. mouse move-and-click). Apex's UI automatically generates PERT charts, which allow modelers to visualize a model's complex parallel behavior. Because interleaving and visualization is now automated, it is feasible to construct arbitrarily long sequences of behavior. To demonstrate the process, we present a model of automated teller interactions in Apex and discuss implications for user modeling. available to model human users, the Goals, Operators, Methods, and Selection (GOMS) method [6, 21] has been the most widely used, providing accurate, often zero-parameter, predictions of the routine performance of skilled users in a wide range of procedural tasks [6, 13, 15, 27, 28]. GOMS is meant to model routine behavior. The user is assumed to have methods that apply sequences of operators and to achieve a goal. Selection rules are applied when there is more than one method to achieve a goal. Many routine tasks lend themselves well to such decomposition. Decomposition produces a representation of the task as a set of nested goal states

that include an initial state and a final state. The iterative decomposition into goals and nested subgoals can terminate in primitives of any desired granularity, the choice of level of detail dependent on the predictions required. Although GOMS has proven useful in HCI, tools to support the construction of GOMS models have not yet come into general use.
Derived from text
Psychomotor Performance; Human Resources; Scheduling; Man Machine Systems

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*.

20030068144 NASA Glenn Research Center, Cleveland, OH, USA
Envisioning a 21st Century, National, Spacecraft Servicing and Protection Infrastructure and Demand Potential: A Logical Development of the Earth Orbit Economy
Horsham, Gary A.; July 2003; 100 pp.; In English; Original contains color and black and white illustrations
Contract(s)/Grant(s): WBS-22-251-30-12
Report No.(s): NASA/TM-2003-212462; NAS 1.15:212462; E-14000; No Copyright; Avail: CASI; A05, Hardcopy

The modern world is extremely dependent on thin strings of several hundred civil, military, and commercial spacecraft/satellites currently stationed in space. They provide a steady stream of commerce, defense, and knowledge data. This dependency will in all likelihood increase significantly during this century. A major disruption of any kind in these essential systems and networks could be socially, economically, and politically catastrophic, on a global scale. The development of a space-based, robotic services economy could be useful in mitigating this growing risk, from an efficiency and security standpoint. This paper attempts to suggest what makes sense to invest in next for the logical, economic development of Earth orbit i.e., after ISS completion. It expands on the results of an advanced market research and analysis study that sampled the opinions of several satellite industry executives and presents these results within a broad policy context. The concept of a spacecraft carrier that serves as the nucleus of a national, space-based or on-orbit, robotic services infrastructure is introduced as the next logical step for USA leadership in space. This is viewed as a reasonable and appropriate followon to the development of ELVs and satellites in the 1950s and 1960s, the Space Shuttle/PRLV in the 1970s and 1980s, and the International Space Station (ISS) in the 1980s, 1990s and 2000s. Large-scale experience in LEO-to-GEO spacecraft/satellite servicing and protection by robotic means is assumed to be an indispensable prerequisite or stepping-stone toward the development and preservation of the large scientific exploration facilities that are envisioned by NASA for operation beyond GEO. A balanced, return on national investment (RONI) strategy for space, focused on the provision of enhanced national/homeland security for increased protection, national economic/industrial expansion for increased revenue, and national scientific exploration for increased knowledge is recommended as the next strong, irrepressible goal toward realizing and achieving the official NASA vision and mission.
Author
Robotics; Spacecraft Maintenance; Orbital Servicing

64
NUMERICAL ANALYSIS

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

20030067930 Rose-Hulman Inst. of Tech., Terre Haute, IN, USA
Genetic Algorithm Tuned Fuzzy Logic for Gliding Return Trajectories
Burchett, Bradley T.; [2003]; 31 pp.; In English
Contract(s)/Grant(s): NAG8-1915; No Copyright; Avail: CASI; A03, Hardcopy

The problem of designing and flying a trajectory for successful recovery of a reusable launch vehicle is tackled using fuzzy logic control with genetic algorithm optimization. The plant is approximated by a simplified three degree of freedom non-linear model. A baseline trajectory design and guidance algorithm consisting of several Mamdani type fuzzy controllers

is tuned using a simple genetic algorithm. Preliminary results show that the performance of the overall system is shown to improve with genetic algorithm tuning.
Author
Trajectory Control; Reusable Launch Vehicles; Fuzzy Systems; Genetic Algorithms

20030067998 Naval Postgraduate School, Monterey, CA
Finite Element Analysis of the Hierarchical Structure of Human Bone
Dolloff, Katherine M.; Mar. 2003; 61 pp.; In English; Original contains color illustrations
Report No.(s): AD-A414879; No Copyright; Avail: CASI; A04, Hardcopy

The objective of this study was to develop an analytical model of the basic hierarchical structure of the human bone. The model computed the stiffness of composite collagen fibers comprised of collagen fibrils and hydroxyapatite mineral crystals. Next, the stiffness of the concentric lamella was computed utilizing the stiffness of the collagen fibers and layer information. Finally, the effective stiffness of the bone was estimated. In order to determine the stiffness of the collagen fiber, a three-dimensional finite element model was developed and a simple analytical model was derived. The simple analytical model was validated using the finite element results. The lamination theory of unidirectional fibrous composites was used to calculate the stiffness of the lamella and eventually the bone stiffness. A series of parametric studies were conducted to understand what parameter(s) affected the stiffness of the bone most significantly. This information will be useful when an artificial bone structure is designed.
DTIC
Finite Element Method; Bones

20030068050 Air Force Inst. of Tech., Wright-Patterson AFB, OH, USA
Categorizing Network Attacks Using Pattern Classification Algorithms
Noel, George E., III; Mar. 2002; 115 pp.; In English; Original contains color illustrations
Report No.(s): AD-A415160; AFIT/GIR/ENG/02M-03; No Copyright; Avail: CASI; A06, Hardcopy

Information systems are often inundated with thousands of attack alerts to distinguish novice hacker probes from genuine threats. Pattern classification can help filter relatively benign attacks from alerts generated by anomaly detectors, limited the numbers of alerts to requiring attention. This research investigates the feasibility of using pattern classification algorithms on network packed header information to classify network attacks. Both liner discrimination and radial basis function algorithms are trained using flood and scan attacks. The classifiers are then tested with unknown floods and scans to determine how well they categorize previously unseen attacks.
DTIC
Algorithms; Computer Networks; Classifications

20030068172 Atmospheric Systems and Analysis, Broomfield, CO, USA
Structure and Variability of Water Vapor in the Upper Troposphere and Lower Stratosphere
Salby, Murry L.; September 8, 2003; 4 pp.; In English
Contract(s)/Grant(s): NAG5-6692; No Copyright; Avail: CASI; A01, Hardcopy

An algorithm has been developed to synoptically-map asynoptic measurements, while rejecting small-scale under-sampled variance that is intrinsic to satellite measurements of water vapor, cloud, and other convective properties. The algorithm has been validated against high-resolution Global Cloud Imagery (GCI) , constructed from 6 satellites simultaneously viewing the global convective pattern. It has been applied to synoptically map Upper-tropospheric humidity (UTH) from UARS/MLS. Mapped distributions of UTH have been used, jointly with the GCI, to study how the upper troposphere is humidified. The time-mean distribution of UTH is spatially correlated to the time-mean distribution of cold cloud fraction eta(sub c) (T less than 230 K). Regions of large UTH coincide with regions of large eta(sub c), which mark deep convection. They also coincide with regions of reduced vertical stability, in which the vertical gradient of Theta is weakened by convective mixing. Coldest cloud cover is attended convective overshoots above the local tropopause, which is simultaneously coldest and highest. Together, these features reflect the upper-troposphere being ventilated by convection, which mixes in air from lower levels.
Derived from text
Water Vapor; Algorithms; Convection; Temporal Distribution

20030068187 NASA Glenn Research Center, Cleveland, OH, USA

Robust and Simple Non-Reflecting Boundary Conditions for the Euler Equations: A New Approach Based on the Space-Time CE/SE Method

Chang, Sin-Chung; Himansu, Ananda; Loh, Ching-Yuen; Wang, Xiao-Yen; Yu, Shang-Tao; July 2003; 38 pp.; In English

Contract(s)/Grant(s): WBS-22-708-48-03

Report No.(s): NASA/TM-2003-212495; E-14051; NAS 1.15:212495; Copyright; Avail: CASI; A03, Hardcopy

This paper reports on a significant advance in the area of non-reflecting boundary conditions (NRBCs) for unsteady flow computations. As a part of the development of the space-time conservation element and solution element (CE/SE) method, sets of NRBCs for 1D Euler problems are developed without using any characteristics-based techniques. These conditions are much simpler than those commonly reported in the literature, yet so robust that they are applicable to subsonic, transonic and supersonic flows even in the presence of discontinuities. In addition, the straightforward multidimensional extensions of the present 1D NRBCs have been shown numerically to be equally simple and robust. The paper details the theoretical underpinning of these NRBCs, and explains their unique robustness and accuracy in terms of the conservation of space-time fluxes. Some numerical results for an extended Sod's shock-tube problem, illustrating the effectiveness of the present NRBCs are included, together with an associated simple Fortran computer program. As a preliminary to the present development, a review of the basic CE/SE schemes is also included.

Author

Space-Time Ce/Se Method; Boundary Conditions

20030068243 Ohio Univ., Athens, OH, USA

Integrated G and C Implementation within IDOS: A Simulink Based Reusable Launch Vehicle Simulation

Fisher, Joseph E.; Bevacqua, Tim; Lawrence, Douglas A.; Zhu, J. Jim; Mahoney, Michael; January 15, 2003; 15 pp.; In English

Contract(s)/Grant(s): NAS8-01105; No Copyright; Avail: CASI; A03, Hardcopy

The implementation of multiple Integrated Guidance and Control (IG&C) algorithms per flight phase within a vehicle simulation poses a daunting task to coordinate algorithm interactions with the other G&C components and with vehicle subsystems. Currently being developed by Universal Space Lines LLC (USL) under contract from NASA, the Integrated Development and Operations System (IDOS) contains a high fidelity Simulink vehicle simulation, which provides a means to test cutting edge G&C technologies. Combining the modularity of this vehicle simulation and Simulink s built-in primitive blocks provide a quick way to implement algorithms. To add discrete-event functionality to the unfinished IDOS simulation, Vehicle Event Manager (VEM) and Integrated Vehicle Health Monitoring (IVHM) subsystems were created to provide discrete-event and pseudo-health monitoring processing capabilities. Matlab's Stateflow is used to create the IVHM and Event Manager subsystems and to implement a supervisory logic controller referred to as the Auto-commander as part of the IG&C to coordinate the control system adaptation and reconfiguration and to select the control and guidance algorithms for a given flight phase. Manual creation of the Stateflow charts for all of these subsystems is a tedious and time-consuming process. The Stateflow Auto-builder was developed as a Matlab based software tool for the automatic generation of a Stateflow chart from information contained in a database. This paper describes the IG&C, VEM and IVHM implementations in IDOS. In addition, this paper describes the Stateflow Auto-builder.

Author

Algorithms; Controllers; Simulation

20030068453 NASA Ames Research Center, Moffett Field, CA, USA

Applications of Space-Filling-Curves to Cartesian Methods for CFD

Aftosmis, Michael J.; Berger, Marsha J.; Murman, Scott M.; May 06, 2003; 9 pp.; In English; 42nd Aerospace Sciences Meeting and Exhibit, Jan 10-13, 2004, Reno, NV, USA

Contract(s)/Grant(s): 704-41-11

Report No.(s): AIAA Paper 2004-Abstract; Copyright; Avail: CASI; A02, Hardcopy

The proposed paper presents a variety novel uses of Space-Filling-Curves (SFCs) for Cartesian mesh methods in 0. While these techniques will be demonstrated using non-body-fitted Cartesian meshes, most are applicable on general body-fitted meshes -both structured and unstructured. We demonstrate the use of single O(N log N) SFC-based reordering to produce single-pass (O(N)) algorithms for mesh partitioning, multigrid coarsening, and inter-mesh interpolation. The intermesh interpolation operator has many practical applications including warm starts on modified geometry, or as an inter-grid transfer operator on remeshed regions in moving-body simulations. Exploiting the compact construction of these operators, we further show that these algorithms are highly amenable to parallelization. Examples using the SFC-based mesh partitioner show

nearly linear speedup to 512 CPUs even when using multigrid as a smoother. Partition statistics are presented showing that the SFC partitions are, on-average, within 10% of ideal even with only around 50,000 cells in each subdomain. The inter-mesh interpolation operator also has linear asymptotic complexity and can be used to map a solution with N unknowns to another mesh with M unknowns with O(max(M,N)) operations. This capability is demonstrated both on moving-body simulations and in mapping solutions to perturbed meshes for finite-difference-based gradient design methods.
Author
Computational Fluid Dynamics; Algorithms

20030068788 Lund Univ., Sweden
Evaporation, Heat Transfer, and Velocity Distribution in Two-Dimensional and Rotationally Symmetrical Laminar Boundary-Layer Flow
Froessling, Nils; Fysiografiska Saellskapets Handlingar; February 1958; Volume 51, No. 4; 38 pp.; In English
Report No.(s): NACA-TM-1432; No Copyright; Avail: CASI; A03, Hardcopy

The fundamental boundary layer equations for the flow, temperature and concentration fields are presented. Two dimensional symmetrical and unsymmetrical and rotationally symmetrical steady boundary layer flows are treated as well as the transfer boundary layer. Approximation methods for the calculation of the transfer layer are discussed and a brief survey of an investigation into the validity of the law that the Nusselt number is proportional to the cube root of the Prandtl number is presented.
Derived from text
Approximation; Boundary Layer Equations; Transition Layers; Laminar Boundary Layer; Heat Transfer

65
STATISTICS AND PROBABILITY

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

20030067825 Naval Postgraduate School, Monterey, CA
The Utility of Higher-Order Statistics in Gaussian Noise Suppression
Green, Donald R.; Mar. 2003; 139 pp.; In English; Original contains color illustrations
Report No.(s): AD-A414802; No Copyright; Avail: CASI; A07, Hardcopy

The properties of higher-order statistics are becoming more and more thoroughly studied in the field of signal processing. One property of great interest is the fact that the cumulants of Gaussian signals disappear entirely at higher orders. Because many noise and interference signals have Gaussian distributions, this property offers the possibility that higher-order statistics may be useful in signal recovery or interference mitigation, which would be of great advantage in military communications, intelligence, or surveillance systems. This thesis examines some of the theory behind higher-order statistics, and discusses the estimation of third-order cumulant values for several random variable distributions. After a minimum sample size has been determined, the study progresses to the frequency domain for an examination of the bispectra of the distributions. The thesis then explores the bispectra of non-Gaussian signals in the presence of Gaussian noise, and concludes with recommendations for implementing signal processing systems which utilize higher-order statistics.
DTIC
Signal Processing; Normal Density Functions; Random Noise

20030067845 Illinois Univ. at Urbana-Champaign, Savoy, IL, USA
Defining the Relationship Between Human Error Classes and Technology Intervention Strategies
Wiegmann, Douglas A.; Rantanen, Eas M.; July 2003; 45 pp.; In English
Contract(s)/Grant(s): NAG1-01026
Report No.(s): AHFD-03-15/NASA-02-1; No Copyright; Avail: CASI; A03, Hardcopy

The modus operandi in addressing human error in aviation systems is predominantly that of technological interventions or fixes. Such interventions exhibit considerable variability both in terms of sophistication and application. Some technological interventions address human error directly while others do so only indirectly. Some attempt to eliminate the occurrence of errors altogether whereas others look to reduce the negative consequences of these errors. In any case, technological interventions add to the complexity of the systems and may interact with other system components in unforeseeable ways and often create opportunities for novel human errors. Consequently, there is a need to develop standards for evaluating the potential safety benefit of each of these intervention products so that resources can be effectively invested to produce the

biggest benefit to flight safety as well as to mitigate any adverse ramifications. The purpose of this project was to help define the relationship between human error and technological interventions, with the ultimate goal of developing a set of standards for evaluating or measuring the potential benefits of new human error fixes.
Derived from text
Human Performance; Pilot Error

66
SYSTEMS ANALYSIS AND OPERATIONS RESEARCH

Includes mathematical modeling of systems; network analysis; mathematical programming; decision theory; and game theory.

20030067685 Newcastle-upon-Tyne Univ., Newcastle
Branching Processes of High-Level Petri Nets
Khomenko, V.; Koutny, M.; Feb. 2003; 26 pp.
Report No.(s): PB2003-105169; CS-TR-763; Copyright; Avail: National Technical Information Service (NTIS)

In this paper, we define branching processes and unfoldings of high-level Petri nets and propose an algorithm which builds finite and complete prefixes of such unfoldings. The advantage of our method is that it avoids a potentially expensive translation of a high-level Petri net into a low-level one. The approach is conservative in the sense that all the verification tools employing the traditional unfoldings can be reused with prefixes derived directly from high-level nets. Our experiments demonstrate that this method is often superior to the usual one, involving the explicit construction of the intermediate low-level net.
NTIS
Branching (Mathematics); Architecture (Computers); Algorithms; Petri Nets

20030067997 Naval Postgraduate School, Monterey, CA
Identification of Commercial Items Risk Factors
Cummins, Robert W., Jr; Mar. 2003; 187 pp.; In English; Original contains color illustrations
Report No.(s): AD-A414876; No Copyright; Avail: CASI; A09, Hardcopy

Since the end of the Cold War, reduced budgets have limited technology growth in the defense industry making the use of Commercial Off-The-Shelf (COTS) software the accepted way to build systems. Twenty years ago, almost all DOD software-intensive systems were built by awarding large multimillion-dollar contracts to defense contractors to build systems from scratch, Consequently, with dwindling budgets, the military has recognized that they can no longer build an infrastructure independent of commercial industry. The use of commercial items does not reduce or eliminate the risks associated with the traditional development of software systems. Numerous programs have stumbled for the lack of careful consideration and identification of the unique risk factors imposed by commercial items. Even though the types of programs are diverse, there are common risk factors that can be identified from the past experiences of these programs. This thesis focuses on the critical risk factors and lessons learned associated with integrating commercial items into DOD software programs. It summarize lessons learn from programs that have made extensive use of commercial items, provides a risk checklist/questionnaire to assist PMs and developers in understanding the risks associated with their developments of a system using commercial items, and suggests mitigation strategies, which can be used as guidelines for the risk factors, to consider when adopting commercial components. Providing the starting point for a systematic structure approach to the risk management of commercial items.
DTIC
Systems Analysis; Commercial Off-The-Shelf Products; Applications Programs (Computers)

20030068071 Naval Postgraduate School, Monterey, CA
Logistical Analysis of the Littoral Combat Ship
Rudko, David D.; Mar. 2003; 96 pp.; In English; Original contains color illustrations
Report No.(s): AD-A415144; No Copyright; Avail: CASI; A05, Hardcopy

The purpose of the Littoral Combat Ship (LCS) is to provide the Navy with an affordable, small, multi-mission ship capable of independent, interdependent, and integrated operations inside the littorals. The LCS will be designed to replace high-value Naval assets when conducting high-end missions such as littoral Anti-Submarine Warfare (ASW), Mine Warfare (MIW), and Anti-Surface Warfare (ASuW) as well as low-end missions such as Humanitarian Assistance (HA), Non-combatant Evacuation Operations (NEO), and Maritime Intercept Operations (MIO). To accomplish these missions and successfully counter the enemy's littoral denial strategy, the Navy has stated that the LCS must incorporate endurance, speed,

payload capacity, sea-keeping, shallow-draft, and mission reconfigurability into a small ship design. Constraints in current ship design technology make this desired combination of design characteristics in small ships difficult to realize at any cost. This thesis analyzes the relationship between speed, endurance, and payload to determine the expected displacement of the LCS; determines the impact of speed, displacement, and significant wave height on LCS fuel consumption and endurance; and analyzes the implications of findings on LCS logistics. The Joint Venture high-speed, wave-piercing catamaran is utilized in this thesis as the LCS seaframe to demonstrate the logistical implications of the speed, endurance, and payload tradeoffs with respect to the modular design of the ship. The weight and space requirement of each onboard and modular system is determined and added to that of the Joint Venture seaframe. Factors considered for full displacement calculations include the base seaframe, installed weapons systems, command and control systems and sensors, personnel and supply load levels, fuel storage capacity, ordnance load levels, and modular systems (embarked manned and unmanned air and sea vehicles). (30 tables, 13 figures, 37 refs.)
DTIC
Ships; Combat; Marine Technology; Design Analysis

67
THEORETICAL MATHEMATICS

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

20030067709 Yale Univ., New Haven, CT
Experiments in Quantum Coherence and Computation with Single Cooper-Pair Electronics
Schoelkopf, R. J.; Nov. 30, 2002; 61 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): DAAD19-99-1-0346
Report No.(s): AD-A414679; ARO-40320-PH-QC; No Copyright; Avail: CASI; A04, Hardcopy

The aim of this project is to measure the coherence time of charge states in the single Cooper-pair box, which is a candidate system for realizing a solid-state, electronic qubit for quantum computation. Techniques for the control and measurement of these states are being developed and applied to demonstrate sufficient coherence to allow quantum computabon. In the past year, we have observed coherent two-level system behavior for our Cooper-pair box qubits through microwave spectrsocopy. We have obtained a worst case estimate of the decoherence time, under conditions of continuous measurement and maximal sensitivity to 1/f charge noise, of about 1 nanosecond. More interestingly, we have also been able to observe a very long (1 microsecond) inelastic lifetime for the qubit to decay into its ground state. This sets an interesting maximal limit on the coherence which could then be almost 1 million times longer than the single-bit operation time, and indicates that the dissipation in Al/AlOx/Al junctions can be very low. In addition, this long lifetime is present in the presence of the measurement by the RF-SET, and implies that high-fidelity single-shot measurements of the qubit state will be possible with this approach.
DTIC
Quantum Computation; Time Measurement

20030068534 China Scientific and Technical Univ., Hefei, China
Calculation of the Electronic Structure of SiCN Crystal by LAPW Method
Zhu, X. L.; Niu, X. B.; Liao, Y.; Yu, L.; Yu, Q. X.; Wang, G. Z.; Fang, R. C.; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003; 1 pp.; In English; See also 20030068525; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

The excellent character and broad potential for application of Silicon Carbon Nitride Film have attracted many researchers in the fields of both condensed matter physics and materials science and engineering, etc. However, most of work concentrates on the preparation of SiCN. Scientists have prepared various SiCN materials, such as SiCN crystal, nanocrystalline, ceramics, etc. Thus we investigate the electronic properties of SiCN crystal using LAPW (linearized Augmented Plane Wave) method in order to give proper interpretation of its characteristic. The LAPW method is among the most accurate methods for performing electronic structure calculations for crystals. It is based on the density functional theory. Because the structure of SiCN crystal is similar to that of __Si3N4, in the course of calculation, we calculate the __Si3N4 firstly, then substitute C atom for Si. We could vary the Si:C:N ratio, and compare the electronic structures in the different ratios of Si:C:N. (In experiment, the average [N] for the crystalline phase is about 50 at %, only slightly than the theoretical value for the C3N4 or Si3N4. the C:Si ratio varies between 5:1 and 1:1 with a mean value around 2:1). This method is used to investigate the intact crystal. We also use supercells, which include several cells of __Si3N4 (or __C3N4) and substitute a Si (or C) atom in it with a C (or Si)

as a defect atom. In this method SiCN is considered as a doped system. We use the GGA (Generalized Gradient Approximation) to do the exchange-correlation potential.
Author
Computation; Electronic Structure; Carbon Nitrides; Silicon Nitrides

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*.

20030067703 Army Armament Research, Development and Engineering Center, Watervliet, NY
Critical Fracture Processes in Army Cannons: A Review
Underwood, John H.; Troiano, Edward; Mar. 2003; 26 pp.; In English; Original contains color illustrations
Report No.(s): AD-A414671; ARCCB-TR-03003; No Copyright; Avail: CASI; A03, Hardcopy

Fast fracture in cannons can well be described using elastic-plastic fracture toughness, in combination with comparisons of cannon section size relative to the size required to maintain plane-strain fracture. Fatigue fracture of cannon tubes is modeled from results of full-size fatigue tests that simulate cannon firing. These tests are also the basis of fatigue-intensity-factor modeling of fatigue life, which incorporates material strength, initial crack size, and Bauschinger-modified autofrettage residual stress into life predictions. Environment-assisted fracture in the thermally damaged near-bore region of fired cannons is shown to be controlled by hydrogen. High-strength cannon steels are susceptible to hydrogen; cannon propellant gases provide the hydrogen; and the source of sustained tensile stress is the near-bore thermal damage and compressive yielding. A thermomechanical model predicts tensile residual stress of similar depth to that of observed hydrogen cracks. Coating fracture in the thermal- damage region of fired cannons is characterized and modeled. The Evans/Hutchinson slip-zone concept is extended to calculate in-situ coating fracture strength from observed crack spacing and hardness in the damaged region. DTIC
Guns (Ordnance); Fracturing; Fatigue Tests

20030067716 British Columbia Univ., Vancouver, British Columbia, Canada
Discrimination and Identification of UXO by Geophysical Inversion. Phase II: Inversion of Total-Field Magnetics
Billings, Stephen D.; Pasion, Leonard R.; Oldenburg, Douglas W.; Apr. 9, 2002; 51 pp.; In English
Contract(s)/Grant(s): DAAD19-00-1-0120
Report No.(s): AD-A414692; ARO-41262.4-EV; No Copyright; Avail: CASI; A04, Hardcopy

A dipole inversion method was developed and successfully applied to the discrimination and identification of unexploded ordnance using total-field magnetometry. A black-white classification of anomalies as ordnance/non-ordnance is not possible using magnetics; rather the items can be ranked according to the likelihood they are UXO. The discrimination method had the potential to reduce the number of excavations at an impact site in Montana (Guthrie Road) by half, yet still yielded all the ordnance. The method requires complete or at least partial shock demagnetization of ordnance, otherwise it is not possible to reliably rank the anomalies. Error analysis indicates that recovered dipole moments are relatively well constrained. However, identification of the anomaly source is difficult using the recovered dipole moment due to non-uniqueness. By recognizing that there are a finite number of ordnance types, correct identification could be achieved in about 55% of cases. Extension of the inversion method to recover either quadrupole of octupole moments did not improve our ability to discriminate or identify. DTIC
Geophysics; Inversions; Error Analysis

20030067727 George Washington Univ., Washington, DC
Identification of Magnetic Materials By Discrete Fourier Analysis
Pardavi-Horvath, Martha; Feb. 20, 2003; 49 pp.; In English; Original contains color illustrations
Contract(s)/Grant(s): DAAD19-02-1-0293
Report No.(s): AD-A414719; ARO-43802-MS-II; No Copyright; Avail: CASI; A03, Hardcopy

A novel approach, linking microstructural effects, magnetic measurements, and signal processing methods, was developed to analyze, identify and compare magnetic materials. The Discrete Fourier Transform (DFT) was applied to DC remanent magnetization curves (RHL) and to Switching Field Distribution (SFD). It was shown analytically how the an, bn Fourier

coefficients depend on the width of SFD, on the coercivity, and on the highest applied field. The field and the coercivity dependences can be separated by using complex Fourier coefficients. The effects of magnetic and sampling parameters on the DFT were numerically simulated. Based on the results of the analytical and numerical study, a measurement and DFT protocol was developed to analyze magnetic materials. The sensitivity of DFT to magnetic markers was investigated numerically, by varying the matrix/marker ratio and the relative coercivities. The measurement and FFT protocol was applied to commercial magnetic media (DELTACARD, METROCARD) and Fe-Zn nanocomposites. The results are submitted to two international conferences. Participation in this complex research gave a significant contribution to the education of two graduate and one undergraduate students..
DTIC
Magnetic Materials; Discrete Functions; Fast Fourier Transformations

20030067767 California Univ., Santa Barbara, CA
High Resolution Transferred Substrate HBT Microwave/RF ADCs
Rodwell, Mark J.; Apr. 21, 2003; 21 pp.; In English
Contract(s)/Grant(s): N00014-96-1-0830
Report No.(s): AD-A414760; No Copyright; Avail: CASI; A03, Hardcopy
The attached report describes development of wideband delta sigma ADOs using high speed Indium Phosphide bipolar transistors.
DTIC
High Resolution; Microwaves; Radio Frequencies

20030067768 Caen Univ., France
High Sensitivity Magnetometers. Sensors and Applications
Nov. 2002; 63 pp.; In English
Contract(s)/Grant(s): F61775-02-W-F077
Report No.(s): AD-A414749; No Copyright; Avail: CASI; A04, Hardcopy
The Final Proceedings for High Sensitivity Magnetometers Sensors and Applications: 4 - 8 November 2002. Magnetic sensors designed to operate both at room temperature and at cryogenic temperatures. Applications of these sensors will also be addressed including non-destructive evaluation of composite materials, magnetic anomaly detection, space magnetism, and geomagnetism.
DTIC
Magnetometers; Conferences; Magnetic Measurement

20030067798 Lawrence Livermore National Lab., Livermore, CA
Modeling of an Inductive Adder Kicker Pulser for Darht-II
Wang, L.; Caporaso, G. J.; Cook, E. G.; Sep. 25, 2000; In English
Report No.(s): DE2003-15003267; UCRL-JC-138438; No Copyright; Avail: National Technical Information Service (NTIS)
An all solid-state kicker pulser for a high current induction accelerator (the Daul-Axis Radiographic Hydrodynamic Test facility DARHT-2) has been designed and fabricated. This kicker pulser uses multiple solid state modulators stacked in an inductive-adder configuration. Each modulator is comprised of multiple metal-oxide-semiconductor field-effect transistors (MOSFFETs) which quickly switch the energy storage capacitors across a magnetic induction core. Metglas is used as the core material to minimize loss. Voltage from each modulator is inductively added by a voltage summing stalk and delivered to a 50 ohm output cable.
NTIS
Magnets; Mathematical Models; Pulse Generators; Radiography; Fabrication

20030067803
HBTprogs Version 1.0
Brown, D. A.; Danielewicz, P.; Mar. 15, 2002; 50 pp.; In English
Report No.(s): DE2003-15003410; UCRL-MA-147919; No Copyright; Avail: Department of Energy Information Bridge
This is the manual for a collection of programs that can be used to invert angled-averaged (i.e. one dimensional two-particle correlation functions). This package consists of several programs that generate kernel matrices (basically the

relative wavefunction of the pair, squared), programs that generate test correlation functions from test sources of various types and the program that actually inverts the data using the kernel matrix.
NTIS
Computer Programs; Wave Functions

20030067964 Argonne National Lab., IL, Deutsches Elektronen-Synchrotron, Hamburg, Germany, Keck Observatory, Kamuela, HI, USA, Thomas Jefferson National Accelerator Facility, Newport News, VA, USA
Experience with EPICS in a Wide Variety of Applications
Krauner, M. R.; Clausen, M.; Lupton, W.; Watson, C.; 2002; 12 pp.; In English
Report No.(s): DE2003-541875; ANL/ASO/CP-92306; No Copyright; Avail: Department of Energy Information Bridge
Currently more than 70 organizations have obtained permission to use the Experimental Physics and Industrial Control System (EPICS), a set of software packages for building real-time control systems. In this paper representatives from four of these sites discuss the reasons their sites chose EPICS, provide a brief discussion of their control system development, and discuss additional control system tools obtained elsewhere or developed locally.
NTIS
Real Time Operation; Applications Programs (Computers)

20030067968 Continuous Electron Beam Accelerator Facility, Newport New, VA, USA
Operating Experience at CEBAF
Legg, R.; 2002; 10 pp.; In English
Report No.(s): DE2003-270664; No Copyright; Avail: Department of Energy Information Bridge
CEBAF, the Continuous Electron Beam Accelerator Facility, is a 5-pass, recirculating, superconducting rf linac designed to provide exceptional beam quality at 4 GeV up to 200(mu)A CW. It is made up of an injector, two 400-MeV linacs, and 9 recirculation arcs having a total beamline length of more than 4.5 km. On Nov. 5, 1995, CEBAF delivered a 4 GeV, 25-(mu)A CW electron beam to the first of 3 experimental halls and the experimental physics program was started 10 days later. Accelerator availability during the first month of the experimental run exceeded 75%. Beam properties measured in the experimental hall to date are a one sigma momentum spread of 5 x 10(sup -5) and an rms emittance of 0.2 nanometer-radians, better than design specification. CW beam has been provided from all 5 passes at 800 MeV intervals. Outstanding performance of the superconducting linacs suggests a machine energy upgrade to 6 GeV in the near term with eventual machine operation at 8-10 GeV. Results f rom commissioning and operations experience since the last conference are presented.
NTIS
Accelerators; Electron Beams

20030068151 Central Lab. of the Research Councils, Warrington, UK
General Model for the Gain of Gas Avalanche Counters
Bateman, J. E.; Apr. 09, 2002; 48 pp.; In English
Report No.(s): PB2003-104827; RAL-TR-2002-0074; Copyright; Avail: National Technical Information Service (NTIS)
A simple, general model of the avalanche process in gas counters is described. Applicable to all the common forms of gas avalanche detector-wire, microstrip, point anode and parallel gap, the model describes the gain process in terms of two pseudo-physical constants which are effectively invariant over the working range of any given detector configuration. For counter operation over a wide range of conditions (e.g. very different gas pressures) the model is extended so that four parameters are required to model the gain. Applications of the model to the characterization, operation and design of a variety of counter types are given.
NTIS
Avalanches; Mathematical Models; Gas Detectors; Ballistics

20030068152 Stanford Linear Accelerator Center, Stanford, CA, USA
Stanford Linear Accelerator Center (SLAC) Celebrating Forty Years: A Photo History 1962-2002
2002; 130 pp.; In English
Report No.(s): PB2003-104538; SLAC-R-605; No Copyright; Avail: CASI; A07, Hardcopy
That 40-year history extends from 1962 through today. Beginning with the visionaries who dreamt of the science that could be explored through electron particle accelerators, it stretches through the lease of the land by Stanford University, to the numerous construction phases, and on through the contributions of thousands of people-scientists, engineers, staff and

administrators-working with one another and collaborating with other scientists from around the world to push forward our understanding of physics.
NTIS
Linear Accelerators; Histories; Research Projects; Particle Theory

20030068169 Brookhaven National Lab., Upton, NY
Ground Motion Activities as DESY: An Overview
Montag, C.; 2002; 10 pp.; In English
Report No.(s): DE2003-805484; BNL-69431; No Copyright; Avail: Department of Energy Information Bridge
Ground motion studies have been performed at DESY for more than a decade, covering beam motion in the two-ring e-p collider NEW, luminosity preservation in Linear Colliders, and active stabilization methods. An overview of past and present activities is given.
NTIS
Luminosity; Particle Accelerators; Earth Movements

20030068174 Department of Energy, Washington, DC
Positron Emission Mammography with Multiple Angle Acquisition
2002; 10 pp.; In English
Report No.(s): DE2003-805771; No Copyright; Avail: Department of Energy Information Bridge
Positron emission mammography (PEM) of F-18 fluorodeoxyglucose (FbG) uptake in breast tumors with dedicated detectors typically has been accomplished with two planar detectors in a fixed position with the breast under compression. The potential use of PEM imaging at two detector positions to guide stereotactic breast biopsy has motivated us to use PEM coincidence data acquired at two or more detector positions together in a single image reconstruction. Multiple angle PEM acquisition and iterative image reconstruction were investigated using point source and compressed breast phantom acquisitions with 5, 9, 12 and 15 mm diameter spheres and a simulated tumor: background activity concentration ratio of 6:1. Additional study is needed to better understand the performance of limited angle tomography for PEM. PEM tomography experiments with complete angular sampling are planned.
NTIS
Mammary Glands; Image Reconstruction; Tumors; Tomography

20030068176 Jefferson (Thomas) Lab. Computer Center, Newport News, VA, USA
Electron-Ion Collider at CEBAF
de Jager, K.; Merminga, L.; Derbenev, Y.; 2002; 8 pp.; In English
Report No.(s): DE2003-805236; No Copyright; Avail: Department of Energy Information Bridge
No abstract available
NTIS
Electron Beams; Linear Accelerators

20030068633 Teikyo Univ. of Science and Technology, Yamanashi, Japan
Diamond Synthesis in Ten Minutes With Closed Reaction Chamber
Gyoda, Kaoru; Tanaka, Yuki; Aoki, Kazuhiro; Takagi, Yoshiki; Proceedings of the Seventh Applied Diamond Conference/ Third Frontier Carbon Technology Joint Conference; August 2003, pp. 557-563; In English; See also 20030068525; Original contains black and white illustrations; No Copyright; Avail: CASI; A02, Hardcopy
Diamond particles were synthesized on Si single crystal substrate in ten minutes reaction time. Reaction chamber was cylindrical shaped with 150mm in diameter and 180mm in height. Our synthesizing method is basically same as conventional hot filament method. Liquid carbon source and hydrogen were introduced to the chamber. Substrate was heated up with tungsten filament radiation to 780 deg C in three minutes. Then temperature was kept for another seven minutes and then cooled down. We got many diamond particles on Si substrate sized from 1 micron up to 10 microns. We tried doping with nickel, phosphorous and boron.
Author
Single Crystals; Synthesis (Chemistry); Vapor Deposition; Diamonds; Cylindrical Bodies

20030068941 New Mexico Univ., Albuquerque, NM, USA
Final Report to the U.S. DOE Research Grant DE-FG03-93-ER 14326
Bryant, H. C.; 1999; 40 pp.; In English
Report No.(s): DE2003-763421; No Copyright; Avail: Department of Energy Information Bridge

This document presents an overview of the results of the DOE'S support of experimental research into the structure and interactions of the negative ion of hydrogen conducted by the Department of Physics and Astronomy of the University of New Mexico at the Los Alamos National Laboratory. The work involves many collaborations with scientists from both institutions, as well as others. Although official DOE support for this work began in 1977, the experiment that led to it was done in 1971, near the time the 800 MeV linear accelerator at Los Alamos (LAMPF) first came on line. Until the mid nineties, the work was performed using the relativistic beam at LAMFF. The most recent results were obtained using the 35 keV injector beam for the Ground Test Accelerator at Los Alamos. A list of all published results from this work is presented.
NTIS
Linear Accelerators; Research And Development

71
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 and Power*.

20030067821 Army Research Lab., Adelphi, MD
An Energy Budget Model to Calculate the Low Atmosphere Profiles of Effective Sound Speed at Night
Tunick, Arnold; May 2003; 30 pp.; In English
Report No.(s): AD-A414792; ARL-MR-563; No Copyright; Avail: CASI; A03, Hardcopy

This report presents an alternate energy budget model to the one implemented in the Acoustic Battlefield Aid (ABFA) for generating low atmosphere profiles of effective sound speed at night. The alternate model is based on the solution of a quartic equation for surface temperature, which assumes a balance between the net long wave) radiative flux and the turbulent fluxes of heat and moisture close to the ground. In contrast, the model in ABFA assumes that the net surface radiation is constant with time at night reduced only in the presence of clouds, and is balanced entirely by the surface heat flux. Therefore, the alternate model may be an improved calculation for this application. However, some difficulties were encountered in the application of traditional Monin-Obukhov (M-O) profile theory for calculating nighttime turbulence structure from wind speed, temperature, and humidity difference data. Model breakdowns were problematic for a nighttime case when surface wind speeds were low, U <4.0 /ms, and skies were clear. During such stable and very stable conditions, the M-O scaling length too often became small--small enough to cause a computational sensitivity. Thus, we recommend that the alternate model in its present form be applied only when surface wind speeds and surface roughness lengths (i.e., canopy heights) can affect values for the M-O scaling length larger than about 13 m.
DTIC
Computerized Simulation; Acoustic Attenuation; Acoustic Velocity

20030068126 NASA Marshall Space Flight Center, Huntsville, AL, USA
Acoustic Wave Propagation in Pressure Sense Lines
Vitarius, Patrick; Gregory, Don A.; Wiley, John; Korman, Valentin; July 14, 2003; 4 pp.; In English; AIAA Conference, 20-23 Jul. 2003, Huntsville, AL, USA; No Copyright; Avail: CASI; A01, Hardcopy

Sense lines are used in pressure measurements to passively transmit information from hostile environments to areas where transducers can be used. The transfer function of a sense line can be used to obtain information about the measured environment from the protected sensor. Several properties of this transfer function are examined, including frequency dependence, Helmholtz resonance, and time of flight delay.
Author
Wave Propagation; Sound Waves; Pressure Measurement

20030068161 Syracuse Univ., NY, USA, Battelle Pacific Northwest Labs., Richland, WA, USA
Acoustic Probe for Solid-Gas-Liquid Suspensions
2002; 7 pp.; In English
Report No.(s): DE2003-13499; No Copyright; Avail: Department of Energy Information Bridge

Acoustic probes have shown promise to be quite effective in determining the solid content in solid-liquid suspensions. However, the presence of small amounts of gas in the waste slurries stored in tanks across the DOE complex prevents straightforward application for characterization of these slurries. The proposed research will develop an acoustic probe for monitoring particle size and volume fraction in slurries in the absence and the presence of gas bubbles. Attenuation of sound waves depends on the size distribution of the solids and the volume fraction of solids. These can in principle be calculated from attenuation measured over a range of frequencies. However, small amounts of bubbles distort the measured attenuation.
NTIS
Solid Suspensions; Acoustic Attenuation; Radioactive Wastes; Liquid-Gas Mixtures; Sensors

20030068274 Swedish Defence Research Establishment, Stockholm, Sweden
Dynamical Detection of Hydroacoustic Signals Recorded at a Sea Trial in the Baltic Sea
Lennartsson, R. K.; Jan. 2002; In English
Report No.(s): PB2003-103166; FOI-R-0370-SE; No Copyright; Avail: National Technical Information Service (NTIS)

In this report we present an acoustic detection study of real-world sonar data, derived from a closely controlled sea trial in the Baltic Sea. Specifically, we discuss the estimation of the parameters of a nonlinear delay differential equation from this data. Using the estimated model parameters as detection features we design signal detectors by implementing a Mahalanobis distance-based decision criteria to perform rigorous hypothesis testing and characterize detection performance. We compare the performance of the dynamical detector with a frequency band matched energy detector and demonstrate that the former provides increased detection performance. Since the dynamical detector is insensitive to signal amplitude, we also design a hybrid detector which combines the dynamical features with an energy feature, and estimates the performance of this detector. We generally find a performance gain for the dynamical detector of 2-6 dB over the energy detector. In the case of the hybrid detector we find similar gains as for the dynamical detector. In no cases does the hybrid detector perform worse than the energy detector or the dynamical detector. The hybrid detector does provide better performance in one case. Hence, in a practical system, the hybrid detector would provide the best performance for all possible signal classes encountered.
NTIS
Underwater Acoustics; Sound Detecting And Ranging; Signal Detectors

20030068382 United Technologies Corp., East Hartford, CT, USA
Advanced Subsonic Technology (AST) Separate-Flow High-Bypass Ratio Nozzle Noise Reduction Program Test Report
Low, John K. C.; Schweiger, Paul S.; Premo, John W.; Barber, Thomas J.; Saiyed, Naseem, Technical Monitor; December 2000; 360 pp.; In English; Original contains color and black and white illustrations
Contract(s)/Grant(s): NAS3-27727; WU 522-81-11
Report No.(s): NASA/CR-2000-210040; E-12238; NAS 1.26:210040; No Copyright; Avail: CASI; A16, Hardcopy

NASA s model-scale nozzle noise tests show that it is possible to achieve a 3 EPNdB jet noise reduction with inwardfacing chevrons and flipper-tabs installed on the primary nozzle and fan nozzle chevrons. These chevrons and tabs are simple devices and are easy to be incorporated into existing short duct separate-flow nonmixed nozzle exhaust systems. However, these devices are expected to cause some small amount of thrust loss relative to the axisymmetric baseline nozzle system. Thus, it is important to have these devices further tested in a calibrated nozzle performance test facility to quantify the thrust performances of these devices. The choice of chevrons or tabs for jet noise suppression would most likely be based on the results of thrust loss performance tests to be conducted by Aero System Engineering (ASE) Inc. It is anticipated that the most promising concepts identified from this program will be validated in full scale engine tests at both Pratt & Whitney and Allied-Signal, under funding from NASA s Engine Validation of Noise Reduction Concepts (EVNRC) programs. This will bring the technology readiness level to the point where the jet noise suppression concepts could be incorporated with high confidence into either new or existing turbofan engines having short-duct, separate-flow nacelles.
Author
Bypass Ratio; Jet Aircraft Noise; Noise Reduction; Subsonic Flow; Technology Assessment; Exhaust Nozzles; Aeroacoustics; Separated Flow

72
ATOMIC AND MOLECULAR PHYSICS

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

20030068575 Osaka Univ., Osaka, Japan

Scanning Tunneling Microscopy Studies of Hydrogenated and Oxygenated CVD Diamond (100) Surfaces

Nakamura, J.; Teraji, T.; Ito, T.; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 259; In English; See also 20030068525; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

We have investigated surface atomic structures of microwave-plasma chemical-vapor-deposited (CVD) homoepitaxial diamond (100) using a scanning tunneling microscope (STM) in ultra-high vacuum. The STM images were taken from H-terminated B-doped diamond (100):H 2x1 structure at plus and minus sample biases. At a plus sample bias, the images related to empty states of the surface atoms were featured by a row separation of 0.50 nm. At a minus sample bias, however, the images corresponding to occupied states were featured by a row separation of 0.25 nm. These STM images are considered to reflect anti-bonding and bonding orbitals of the surface C-H bonds related to the 2x1 structure, respectively. We also observed STM images of O-terminated B-doped diamond (100) surfaces. The STM images taken from an O-terminated surface showed a regular structure reflecting the 2x1 structure that had formed before the oxidization. This indicates that a moderate oxidation can keep the surface atomic regularity of the 2x1-structured H-terminated diamond (100). Furthermore, from these observations, possible oxygen sites bonded to the diamond (100):H 2x1 surface are discussed in relation to the amount of hydrogen in the CVD diamond surface.

Author

Atomic Structure; Plasmas (Physics); Diamonds; Vapor Deposition; Scanning Tunneling Microscopy; Oxygenation; Hydrogenation

20030068696 Cambridge Univ., Cambridge, UK

Resonant Raman Spectra of Carbon Systems

Robertson, J.; Ferrari, A. C.; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 389-394; In English; See also 20030068525; Original contains color illustrations; No Copyright; Avail: CASI; A02, Hardcopy

Raman spectroscopy is a non-destructive means to characterise many carbon systems, including diamond, graphite, nano-diamond, carbon nanotubes, diamond-like carbon and carbon nitride alloys. Raman at a single wavelength excitation gives only limited information. We review here how multi-wavelength Raman gives much more information on these phases, because it uses the resonant Raman condition.

Author

Graphite; Raman Spectroscopy; Carbon

20030068700 MolecularDiamond Technologies, Richmond, CA, USA

Higher Diamondoids: A New Class Of 3-D Diamond Molecules 1 To 2 nm in Size

Dahl, J. E.; Liu, S. G.; Carlson, R. M. K.; Qureshi, W.; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 526; In English; See also 20030068525; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

Hydrogen-terminated diamonds form a continuous series of molecules ranging in size from macroscopic diamonds, to micron-sized diamonds (including CVD diamonds), to ultra-nanocrystalline diamonds (including ion implant and detonation diamonds as small as 2 to 3 nm), to higher diamondoids (recently isolated for the first time by us, and having sizes from ~1 to 2 nm), finally ending with the lower diamondoids of which, adamantane, consisting of one C10 diamond crystal lattice cage, is the smallest. Except for the higher diamondoids, which have not been available until now, all of these forms have been studied, characterized and used in a variety of applications. We have identified and isolated higher diamondoids (C22 and higher polymantanes) including tetramantanes, pentamantanes, hexamantanes, heptamantanes, octamantanes, nonamantanes, a decamantane and an undecamantane from petroleum. These molecules contain from four to eleven diamond crystal cages face-fused in a variety of ways to give a variety of geometries. Exceptional thermal stability and diverse geometries make possible their isolation from petroleum. Structures were proven by single crystal X-ray crystallography for selected members of three families of higher diamondoids. As members of the H-terminated diamond series, these molecules have great strength and rigidity, but they also show a remarkable variety of 3-dimensional shapes, including resolvable chiral forms (some with

unusual primary helical structures, where the helicity is built into the backbone of the molecule, rather than arising from steric effects, such as in the helicenes). Properties of higher diamondoids can be tuned by the attachment of various functional groups, allowing customized mechanical, electronic and biomedical properties. The combination of diamond structure and versatile derivative chemistries, gives these 3-D, 1-2 nm size, chiral/achiral higher diamondoids potential for applications in a wide range of fields, including pharmaceuticals, microelectronics, optics, lubricants, and specialty chemicals. They are useful molecular building blocks that may find applications in nanotechnology and new nanostructured materials. Research quantities of higher diamondoids will be produced this year and larger quantities in the future.
Author
Carbon; Nanocrystals; Crystal Structure

73
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*.

20030068135 NASA Langley Research Center, Hampton, VA, USA
Bringing an Effective Solar Sail Design Toward TRL 6
Lichodziejewski, David; West, John; Reinert, Rich; Belvin, Keith; Pappa, Richard; Derbes, Billy; [2003]; 8 pp.; In English; AIAA Joint Propulsion Conference and Exhibit, 20-23 Jul. 2003, Huntsville, AL, USA
Contract(s)/Grant(s): NAS8-03046
Report No.(s): AIAA Paper 2003-4659; Copyright; Avail: CASI; A02, Hardcopy

Solar sails reflect photons streaming from the sun and convert some of the energy into thrust. This thrust, though small, is continuous and acts for the life of the mission without the need for propellant (I) . Recent advances in sail materials and ultra-low mass structures have enabled a host of useful missions utilizing solar sail propulsion. The team of L Garde, Jet Propulsion Laboratories, Ball Aerospace, and Langley Research Center, under the direction of NASA, has been developing a solar sail configuration to address NASA s future space propulsion needs. Utilizing inflatably deployed and Sub Tg rigidized boom components, this 10,000 sq m sailcraft achieves an areal density of 14.1 g/sq m and a characteristic acceleration of 0.58 mm/s . The entire configuration released by the upper stage has a mass of 232.9 kg and requires just 1.7 d of volume in the booster. After deployment, 92.2 kg of non-flight required equipment is jettisoned resulting in a sailcraft mass, including payload and control system, of 140.7 kg. This document outlines the accomplishments of a Phase 1 effort to advance the technology readiness level (TRL) of the concept from 3 toward a TRL of 6. The Phase 1 effort, the first of three proposed phases, addressed the design of the solar sail, its application to several missions currently under review at NASA, and developed a ground tes plan to bring the technology toward a TRL of 6.
Author
Payload Control; Photons; Propulsion; Solar Sails

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OPTICS

Includes light phenomena and the theory of optical devices; for specific optical devices see also *35 Instrumentation and Photography*. For lasers see *36 Lasers and Masers*.

20030068117 NASA Marshall Space Flight Center, Huntsville, AL, USA
Two Color Interferometry with Nonlinear Refractive Properties
Vikram, Chandra S.; Witherow, William K.; [2002]; 1 pp.; In English; No Copyright; Avail: Other Sources; Abstract Only

Using nonlinear refractive properties of salt-water solution at two wavelengths, numerical analysis has been performed to extract temperature and concentration from virtual interferometric fringe data. The theoretical study, using a commercially available equation solving tool, starts with critical fringe counting needs and the role of nonlinear refractive properties in such measurements. Finally, methodology of the analysis, developed codes, and fringe counting accuracy needs are described in detail.
Author
Interferometry; Color; Numerical Analysis; Refractivity

20030068234 NASA Marshall Space Flight Center, Huntsville, AL, USA

X-Ray Testing Constellation-X Optics at MSFC's 100-m Facility

O'Dell, Stephen; Baker, Markus; Content, David; Freeman, Mark; Glenn, Paul; Gubarev, Mikhail; Hair, Jason; Jones, William; Joy, Marshall, et al.; [2003]; 2 pp.; In English; Optics for EUV, X-Ray, and Gamma-Ray Astronomy, 3-8 Aug. 2003, San Diego, CA, USA; No Copyright; Avail: Other Sources; Abstract Only

In addition to the 530-m-long X-Ray Calibration Facility (XRCF), NASA's Marshall Space Flight Center (MSFC) operates a 104-m-long (source-to-detector) X-ray-test facility. Originally developed and still occasionally used for stray-light testing of visible-fight optical systems, the so-called 'Stray-Light Facility' now serves primarily as a convenient and inexpensive facility for performance evaluation and calibration of X-ray optics and detectors. The facility can accommodate X-ray optics up to about 1-m diameter and 12-m focal length. Currently available electron-impact sources at the facility span the approximate energy range 0.2 to 100 keV, thus supporting testing of soft- and hard-X-ray optics and detectors. Available MSFC detectors are a front-illuminated CCD (charge-coupled device) and a scanning CZT (cadmium--zinc--telluride) detector, with low-energy cut-offs of about 0.8 and 3 keV, respectively. In order to test developmental optics for the Constellation-X Project, led by NASA's Goddard Space Flight Center (GSFC), MSFC undertook several enhancements to the facility. Foremost among these was development and fabrication of a five-degree-of-freedom (5-DoF) optics mount and control system, which translates and tilts the user-provided mirror assembly suspended from its interface plate. Initial Constellation-X tests characterize the performance of the Optical Alignment Pathfinder Two (OAP2) for the large Spectroscopy X-ray Telescope (SXT) and of demonstration mirror assemblies for the Hard X-ray Telescope (HXT). With the Centroid Detector Assembly (CDA), used for precision alignment of the Chandra (nee AXAF) mirrors, the Constellation-X SXT Team optically aligned the individual mirrors of the OAPZ at GSFC. The team then developed set-up and alignment procedures, including transfer of the alignment from the optical alignment facility at GSFC to the X-ray test facility at MSFC, using a reference flat and fiducials. The OAPZ incorporates additional ancillary features --- fixed aperture mask and movable sub-aperture mask --- to facilitate X-ray characterization of the optics. Although the OAPZ was designed to- have low sensitivity to temperature offsets and gradients, analyses showed the necessity of active temperature control for the X-ray performance testing. Thus, the Smithsonian Astrophysical Observatory (SAO) implemented a thermal control and monitoring system, designed to hold the OAP2 close to its assembly.

Author

Performance Tests; Active Control; X Ray Astrophysics Facility; Optical Equipment; Light Emission

20030068304 Swedish Defence Research Establishment, Stockholm, Sweden

Image Intensifiers for the Protection of Eyes against Lasers

Svensson, S.; Nilsson, C.; Kariis, H.; Heimdal, L.; Mar. 2002; In Swedish

Report No.(s): PB2003-104305; FOI-R-0458-SE; No Copyright; Avail: National Technical Information Service (NTIS)

The military interest in image intensifiers has traditionally been focused on low light level operations. Developments in laser technology are increasing the risk that the eyes of military personnel will be harmed by laser radiation. Many nations are developing protective technologies against lasers with unpredictable wavelengths. Reasonably safe devices that allow visual contact with the surroundings are likely to be on the market in 5 to 10 years time. Compared with conventional filter glasses these new devices will be more expensive and more cumbersome since they will contain a number of optical components. The use of image intensifiers during daytime is a reasonably safe practice for eye protection if the eyes are shielded against exposure beside the intensifier. Under low light conditions image intensifiers will also increase the safety margin. Within the next 5 years image intensifiers will often be the only feasible means to protect the eye. These facts should be considered in the defense material purchasing process and should also be pointed out during training of personnel. The use of image intensifiers, however, will impair the user's comfort, visual capacity and endurance. The intensifier itself may be damaged or jammed and although the eyes are protected, the task under hand may become impossible.

NTIS

Eye Protection; Image Intensifiers; Laser Applications

20030068495 Blue Road Research, Gresham, OR, USA

Development and Evaluation of Fiber Optic Sensors

Udd, E.; Kunzler, M.; May 2003; In English

Report No.(s): PB2003-106652; No Copyright; Avail: National Technical Information Service (NTIS)

This study investigated the feasibility of using fiber optic sensors to capture traffic data. Funding from the study was used to develop a prototype sensor using fiber Bragg gratings (FBG) technology. The sensor was tested on a high volume portland cement concrete highway and found to be feasible for use in monitoring light and heavy traffic. Signals from the senor were

processed with a demodulator system, and captured on a computer. For testing purposes, the signal was converted to a scaled analog voltage signal and successfully output to a conventional traffic classifier recorder. The sensors have the potential for long-lasting, cost-effective solutions in vehicle classification applications. With modification, the FBG strain sensor shows potential for use in weigh-in-motion applications. The system is sensitive enough to detect adjacent lane traffic, opening possibilities of shoulder area monitoring for less traffic disruption and increased safety. With two sensors, the system can capture speeds as well as weights of both sides of a vehicle. Future development of dedicated demodulator/interfacing electronic hardware and auto-tuning grating system could eventually lead to cost effective solutions for traffic classification and weigh-in-motion applications.
NTIS
Fiber Optics; Sensors; Bragg Gratings

20030068610 Uppsala Univ., Uppsala, Sweden
Diamond Micro-Optics
Karlsson, M.; Hoegstroem, H.; Nikolajeff, F.; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 115-119; In English; See also 20030068525; Original contains black and white illustrations; No Copyright; Avail: CASI; A01, Hardcopy

We have developed a method for fabricating almost any type of optical surfaces in diamond. The method consists of the following steps: First, a polymer film, spun onto diamond substrates of optical quality, is patterned by lithographic processes. Next, the surface relief is transferred into the underlying diamond by use of inductively coupled plasma dry etching in an oxygen/argon chemistry. Using this technique, we have successfully demonstrated the fabrication of diamond spherical microlenses, blazed gratings, Fresnel lenses, subwavelength gratings and diffractive fan-out elements. The spherical microlenses had apertures of 90 m and f-number of 4. The phase error, measured with a Twyman-Green interferometer at 633 nm, was found to be less than 31 nm. The diffraction efficiency for the blazed grating was measured to be 68% at 400 nm, with a theoretical maximum of 71%. The subwavelength grating was designed for reducing surface reflections at a wavelength of 10.6 m. Spectrophotometric results show that the optical transmission was increased from 70%, using a non-structured diamond substrate, to 97%, using our subwavelength structured diamond. Finally, the fan-out element has been tested with a 6 kW carbondioxide laser, to microstructure pieces of PMMA. The results are excellent, showing diffraction limited spots.
Author
Microstructure; Diamonds; Diffractive Optics; Antireflection Coatings

20030068890 NASA Marshall Space Flight Center, Huntsville, AL, USA
Panoramic Refracting Conical Optic
Lindner, Jeffrey L., Inventor; June 17, 2003; 7 pp.; In English
Patent Info.: Filed 17 Jun. 2002; No Copyright; Avail: CASI; A02, Hardcopy

An optical device having a semi-spherical or hemispherical field-of-view is provided. A conically-shaped piece of optical material has an annular surface satisfying Snell's Law for total internal reflection with respect to light passing through the piece and incident on the annular surface from within the piece.
Official Gazette of the U.S. Patent and Trademark Office
Optical Equipment; Refraction

20030068899 NASA Marshall Space Flight Center, Huntsville, AL, USA
Figure Measurements of High-Energy-X-Ray Replicated Optics
Gubarev, Mikhail; Ramsey, Brian; Kester, Thomas; Engelhaupt, Darell; Speegle, Chet; Martin, Greg; [2003]; 2 pp.; In English; Optics for EUV, X-Ray, and Gamma-Ray Astronomy, 3-8 Aug. 2003, San Diego, CA, USA; Copyright; Avail: Other Sources; Abstract Only

We are developing grazing incidence x-ray optics for a balloon-borne hard-x-ray telescope (HERO). The HERO mirror shells are fabricated using electroform-nickel replication off super-polished cylindrical mandrels. One of the sources for mirror resolution error is departure of the shell figure from prescription. We have modified a Vertical-scan Long Trace Profilometer (VLTP) in order to measure the figure of the inner surface of the HERO mirror shells for diameters as small as 76 mm. Mirror alignment method and sources for systematic errors will be discussed. Comparison of figure metrology of the mandrel and the shells will be presented together with results from x-ray tests.
Author
Grazing Incidence; X Ray Optics; X Ray Telescopes; Balloon-Borne Instruments; Metrology; Fabrication

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PLASMA PHYSICS

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

20030067805 Troitsk Innovation and Fusion Research Inst., Troitsk, Russia
Magnetosonic Eigenmodes near the Magnetic Field Well in a Spherical Torus
Goerelenkova, M. V.; Gorelenkov, N. N.; Jul. 07, 1996; 16 pp.; In English
Report No.(s): DE2003-16721; No Copyright; Avail: Department of Energy Information Bridge

The structure and spectrum of magnetosonic Alfven eigenmodes in spherical torus in the presence of magnetic field well are studied. Analytical solution for eigenmodes localized in the well is obtained and compared with the numerical one. The possibility of using the eigenmode spectrum measurements for reconstructing the magnetic field well, and, thus, central magnetic safety factor profile is discussed.
NTIS
Eigenvalues; Magnetic Fields

20030068292 Swedish Defence Research Establishment, Linkoeping
High-Pressure Plasmas for Radar Wave Absorption
Serdyuk, Y.; Bondeson, A.; Gubanski, S.; May 2002; In Swedish; In English
Report No.(s): PB2003-104301; FOI-R-0482-SE; No Copyright; Avail: National Technical Information Service (NTIS)

Possible ways of generating plasmas with sufficiently high electron density and gas pressure for efficient absorption of radar waves are studied by means of numerical solution of fluid equations and analytical estimates, using available coefficients on ionization and recombination. It is found that helium, or a helium-argon mixture is the most suitable gas. The computational modeling in two dimensions indicates that stable discharges can be generated with dielectric-coated electrodes at driving frequencies in the range of 1 MHz. One-dimensional computations were undertaken and reached densities in the vicinity of the required values. One problem is the rather high power consumption that is expected for a sufficiently dense plasma. Both the numerical simulations and theoretical estimates indicate that the required power consumption is in the range of several tens of kW/m2. In order to obtain more conclusive results, an experimental test would be necessary. The study was carried out at the Department of Electrical Power Engineering and Department of Electromagnetics at Chalmers, from October 2001 until March 2002, and was supported by FMV and FOI.
NTIS
Dielectrics; Plasmas (Physics); Absorption

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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*.

20030067934 NASA Marshall Space Flight Center, Huntsville, AL, USA
A Theory of the von Weimarn Rules Governing the Average Size of Crystals Precipitated from a Supersaturated Solution
Barlow, Douglas A.; Baird, James K.; Su, Ching-Hua; [2003]; 1 pp.; In English; Copyright; Avail: Other Sources; Abstract Only

More than 75 years ago, von Weimarn summarized his observations of the dependence of the average crystal size on the initial relative concentration supersaturation prevailing in a solution from which crystals were growing. Since then, his empirically derived rules have become part of the lore of crystal growth. The first of these rules asserts that the average crystal size measured at the end of a crystallization increases as the initial value of the relative supersaturation decreases. The second rule states that for a given crystallization time, the average crystal size passes through a maximum as a function of the initial relative supersaturation. Using a theory of nucleation and growth due to Buyevich and Mansurov, we calculate the average crystal size as a function of the initial relative supersaturation. We confirm the von Weimarn rules for the case where the nucleation rate is proportional to the third power or higher of the relative supersaturation.
Author
Crystal Growth; Supersaturation; Crystallization

20030068120 NASA Marshall Space Flight Center, Huntsville, AL, USA
Limiting Step Bunch Height During Crystal Growth from Flowing Solutions
Booth, N. A.; Chernov, A. A.; Vekilov, P. G.; January 2003; 1 pp.; In English
Contract(s)/Grant(s): NAS8-02096; No Copyright; Avail: Other Sources; Abstract Only

High precision interferometric studies of step bunching on KDP crystal surface growing from solution moving at rates up to 1 d s . It is shown that the bunch height is limited as the bunch propagates over the surface. An hypothesis is put forward describing why the bunch height decreases as the solution flow rate increases.
Author
Crystal Surfaces; Interferometry; Hypotheses

20030068134 NASA Marshall Space Flight Center, Huntsville, AL, USA
Binary-Phase Fourier Gratings for Nonuniform Array Generation
Keys, Andrew S.; Crow, Robert W.; Ashley, Paul R.; [2003]; 1 pp.; In English; SPIE Annual Meeting 2003, 3-8 Aug. 2003, San Diego, CA, USA
Contract(s)/Grant(s): MIPR-62R-251-96-9396-01; No Copyright; Avail: Other Sources; Abstract Only

We describe a design method for a binary-phase Fourier grating that generates an array of spots with nonuniform, user-defined intensities symmetric about the zeroth order. Like the Dammann fanout grating approach, the binary-phase Fourier grating uses only two phase levels in its grating surface profile to generate the final spot array. Unlike the Dammann fanout grating approach, this method allows for the generation of nonuniform, user-defined intensities within the final fanout pattern. Restrictions governing the specification and realization of the array's individual spot intensities are discussed. Design methods used to realize the grating employ both simulated annealing and nonlinear optimization approaches to locate optimal solutions to the grating design problem. The end-use application driving this development operates in the near- to mid-infrared spectrum - allowing for higher resolution in grating specification and fabrication with respect to wavelength than may be available in visible spectrum applications. Fabrication of a grating generating a user-defined nine spot pattern is accomplished in GaAs for the near-infrared. Characterization of the grating is provided through the measurement of individual spot intensities, array uniformity, and overall efficiency. Final measurements are compared to calculated values with a discussion of the results.
Author
Design Analysis; Binary Data; Fourier Transformation

20030068182 California Univ., Berkeley, CA
In situ Nanoindentation in a Transmission Electron Microscope
Minor, A. M.; 2002; 122 pp.; In English
Report No.(s): DE2003-807441; No Copyright; Avail: Department of Energy Information Bridge

This dissertation presents the development of the novel mechanical testing technique of in situ nanoindentation in a transmission electron microscope (TEM). This technique makes it possible to simultaneously observe and quantify the mechanical behavior of nano-scale volumes of solids.
NTIS
Nanoindentation; Transmission Electron Microscopy

20030068366 Brookhaven National Lab., Upton, NY, USA
Collider Accelerator Complex
1999; 216 pp.; In English
Report No.(s): DE2003-354999; No Copyright; Avail: Department of Energy Information Bridge

Contents include the following: FY 1996 AGS Schedule as Run; FY 1997 AGS Schedule as Run; FY 1998 AGS Schedule as Run; FY 1999 AGS Schedule (in progress); AGS Beams 1998; AGS Experimental Area FY 1996 Physics Program; AGS Experimental Area FY 1997 Physics Program; AGS Experimental Area FY 1998-1999 Physics Program; A Listing of Experiments by Number; Two-Page Summaries of Each Experiment, in Order By Number; Listing of Publications of AGS Experiments; Listing of Experimenters in Alphabetical Order.
NTIS
Schedules; Accelerators

20030068522 NASA Marshall Space Flight Center, Huntsville, AL, USA

Phase Sensitive X-Ray Diffraction Imaging Study of Protein Crystals

Hu, Z. W.; [2003]; 1 pp.; In English; Advanced Photon Source Seminar, 30 Jun. 2003, Chicago, IL, USA

Contract(s)/Grant(s): NAS8-02096; No Copyright; Avail: Other Sources; Abstract Only

The study of defects and growth of protein crystals is of importance in providing a fundamental understanding of this important category of systems and the rationale for crystallization of better ordered crystals for structural determination and drug design. Yet, as a result of the extremely weak scattering power of x-rays in protein and other biological macromolecular crystals, the extinction lengths for those crystals are extremely large and, roughly speaking, of the order of millimeters on average compared to the scale of micrometers for most small molecular crystals. This has significant implication for x-ray diffraction and imaging study of protein crystals, and presents an interesting challenge to currently available x-ray analytical techniques. We proposed that coherence-based phase sensitive x-ray diffraction imaging could provide a way to augment defect contrast in x-ray diffraction images of weakly diffracting biological macromolecular crystals. I shall examine the principles and ideas behind this approach and compare it to other available x-ray topography and diffraction methods. I shall then present some recent experimental results in two model protein systems-cubic apofemtin and tetragonal lysozyme crystals to demonstrate the capability of the coherence-based imaging method in mapping point defects, dislocations, and the degree of perfection of biological macromolecular crystals with extreme sensitivity. While further work is under way, it is intended to show that the observed new features have yielded important information on protein crystal perfection and nucleation and growth mechanism otherwise unobtainable.

Author

Imaging Techniques; Protein Crystal Growth; X Ray Diffraction; Sensitivity; Phase Transformations

20030068530 Nippon Inst. of Tech., Japan

Processing of Diamonds by Short Pulse Lasers

Miyazawa, H.; Takeuchi, S.; Shihoyama, K.; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 201-206; In English; See also 20030068525; No Copyright; Avail: CASI; A02, Hardcopy

A study on the processing of diamonds using two kinds of short pulse lasers was conducted. Diamonds used are single crystals synthesized at high temperature and high pressure, and platelet single crystal synthesized by the chamber-flame CVD method. Polycrystalline diamond film synthesized by the CVD method was also used. ArF excimer laser with pulse width of 20 nanoseconds, and a Ti-sapphire laser with pulse width of 150 femtoseconds were used. A laser beam was introduced to focus on the surface of the specimen in air. Results obtained are summarized as follows. In excimer laser processing, (1) only a slight difference the grooving properties is observed for various single-crystal diamonds, and (2) polycrystalline diamond is processed more easily than single-crystal diamonds. In the processing using the femtosecond laser, (1) combinations of high output energy and low beam scan speed produce a high-quality groove with straight wall and sharp edge, (2) other combinations of the parameters produce grooves having defects such as crack formation and/or attachment of by-product both in and outside of the groove, or having a narrow neck on the upper portion of the groove, and (3) controlled processing conditions can realize clean processing with no heat-affected zones on the surface of the groove.

Author

Diamonds; Laser Applications; Pulsed Lasers; Excimer Lasers; Processing

20030068537 Osaka Univ., Osaka, Japan

Achievement of 10(exp 14)[1/sq cm] Surface Hole Carrier Density on Diamond Film by the Sulfur Hexafluride Incorporated Hydrogen Plasma Post-Treatment

Ota, Go; Kobayashi, Takeshi; Kim, Sung-Hoon; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 569-572; In English; See also 20030068525; Original contains black and white illustrations; No Copyright; Avail: CASI; A01, Hardcopy

This paper deals with manipulation of the surface hole areal density of diamond films by a new treatment method. Our proposal is characterized by a post-treatment of as-grown diamond film surface in (H2+SF6) microwave plasma, where SF6 incorporation was around 0.06 % or less. With increasing the treatment time up to 4 min, the surface resistivity changed from 5 x 10(exp 5) [* /**] down to 4 x 10(exp 2)[*/**] and, on the other hand, hole areal density increased from 2 x 10(exp 13) to 1 - 2 x 10(exp 14) [1/sq cm]. In addition, these values did not affected at all by the measurement atmospheres. With further increase in the treating-time, however, those electrical properties began to degrade. As to the role of (H2+SF6) plasma

treatment of diamond film surface, a charge transfer model was given for explanation from chemiphysical point of view. Author

Diamond Films; Sulfur Hexafluoride; Hydrogen Plasma

20030068538 North Fluminense State Univ., Rio de Janeiro, Brazil

Diamond Spontaneous Crystallization From Mg-Ni-C System at HPHT

Bobrovnitchii, G. S.; Osipov, A. S.; Skury, A. L. D.; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 592-596; In English; See also 20030068525; Original contains black and white illustrations; No Copyright; Avail: CASI; A01, Hardcopy

In this work, different Mg-Ni alloys were used as carbon solvents in the synthesization of diamonds at a pressure of 7.7 GPa and temperatures of 1473 to 2073 K. All the alloys were melted by a special treatment at high pressure. The temperature ranges were determined for spontaneous diamond crystallization, using Mg2Ni, MgNi2 compounds and two eutectic alloys, according to the Mg-Ni phase diagram. Diamonds were observed to form at temperatures exceeding 1873 K when Mg2Ni and 0.89at.%Mg+0.11at.%Ni alloys were used as carbon solvents. X-ray diffraction patterns revealed the presence of MgO. Spontaneous diamond crystallization was found to occur above 1573 K, using the MgNi2 alloy. Cubo-octahedral morphology of diamond crystals were detected at temperatures of 1723-1823 K. Intense spontaneous diamond crystallization was observed at temperatures of 1573 K and upward when the eutectic 0.23at.%Mg+0.77at.%Ni alloy was employed. Unlike the behavior with the MgNi2 alloy, the rate of spontaneous crystallization increased, as did the number of crystallization centers. The MgNi2 carbon solvent alloy was found to be preferable for the synthesis of high-quality diamond crystals. Author

Diamonds; Crystallization; Magnesium Alloys; Nickel Alloys

20030068545 Japan Fine Ceramics Center, Japan

High-Density Electron Emission From Ion-Implanted Diamond

Sakai, Tadashi; Ono, Tomio; Suzuki, Mariko; Sakuma, Naoshi; Yoshida, Hiroaki; Hasegawa, Masataka; Okushi, Hideyo; Koga, Yoshinori; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 129; In English; See also 20030068525; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

We report high-density electron emission characteristics from ion-implanted homo-epitaxial diamond. At the previous this conference, we had reported over 100mA/sq cm electron emission from a sulfur-ion implanted homo-epitaxial diamond. To find best ion-species and implant-conditions, three types of ions such as phosphor, boron and sulfur have been implanted and their characteristics were evaluated. Among the above species, the phosphor-ion implanted sample showed highest electron emission density over 1A/sq cm with emission area of 300,microns in diameter. We believe that this is one of the largest emission density values for carbon-based materials under a large emission area measurement. From the measurement of electron emission, maximum emission densities of individual samples were found to exclusively obey to their surface conductivity rather than the implanted ion-species. Also, a graphitized defect was observed at the surfaces of well emitting samples. These results and emission characteristics indicated that high-density electron emission is strongly related to the conductive carbon structure together with the semiconducting diamond matrix. Detailed emission characteristics and emission models will be discussed. Author

Electron Emission; Epitaxy; Diamonds; Ion Implantation; Sulfur

20030068549 Academy of Sciences (Russia), Ekaterinburg, Russia

Effect of Temperature and Ion Bombardment on DLC Relief Generation and Modification

Rubshtein, A. P.; Trakhtenberg, I. S.; Yugov, V. A.; Plotnikov, S. A.; Ponosov, Y. S.; Vladimirov, A. B.; Uemura, Kensuke; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 472-477; In English; See also 20030068525; Original contains black and white illustrations; No Copyright; Avail: CASI; A02, Hardcopy

DLC were deposited by arc-pulse sputtering of graphite. Raman spectroscopy was used for determination of sp3/sp2 ratio. DLC deposition temperature was varied by change of pulse frequency. After deposition DLC were etched by argon or oxygen ions (E = 3 keV). Study of DLC surface relief were carried out by means of atomic-force and laser microscopes. It is shown that DLC surface has domain-like structure with ranges of peaks along boundaries. Separate protrusions are observed on DLC surface. Their height is comparable to coating thickness. Generation of DLC relief strongly depends on intensity of diffusion

process taking place on the growing film surface. Increase of deposition temperature leads to growth of rough relief (agglomerations of protrusions). DLC relief modification by ion bombardment depends on chemical type of ions. There are peculiarities of DLC relief modification by reactive oxygen and inert argon. The peculiarities are related with changing of different components of DLC relief by oxygen and argon. Argon bombardment lowers the height of peaks and partially removes them from DLC surface without noticeable change of protrusions and areas of inside domains. Oxygen etching (physical and chemical) smoothes areas of inside domains, decreases height of protrusions and makes the hollows near peaks deeper.
Author
Ion Irradiation; Sputtering; Graphite; Diamonds; Carbon

20030068562 Nippon ITF, Inc., Kyoto, Japan
Various Applications of DLC Including Flexible DLC-Coated Rubber Components
Ohara, Hisanori; Nakahigashi, Takahiro; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 407-412; In English; See also 20030068525; Original contains black and white illustrations; No Copyright; Avail: CASI; A02, Hardcopy

DLC (Diamond-Like Carbon), a kind of the hard carbon film, has such features as the lowest friction coefficient among various ceramic coating materials, high hardness, and less damage in the counterparts. Because of these features, many developments regarding application for various kinds of sliding parts are in progress. However, people now call other films DLC, too, even though they are different from those defined in '80s. Moreover, new manufacturing methods such as sputtering and cathodic arc ion-plating are now used in addition to the conventional ones such as the radio frequency (rf) plasma assisted chemical vapor deposition (PACVD) and the ion beam deposition. It is required to use these DLCs properly for each usage. Another topic in these days is a flexible DLC film that uses rubber as the substrate material instead of the generally used substrate materials such as metals and ceramics. This new DLC film is applied to the rubber seal ring (O-ring) for zoom lens system of 35 mm compact cameras. This paper reviews the technological trend of various applications of the recent DLC films including flexible DLC films coated on rubber components.
Author
Carbon; Coatings; Diamonds; Rubber; Technologies; Flexibility; Components

20030068566 China Scientific and Technical Univ., Hofei, China
Electron Emission and Raman Investigation of Hydrogenated Diamond Like Carbon Prepared by Pulsed Laser Deposition
Yu, Lin; Wu, Qi-Hong; Liao, Yuan; Yu, Qing-Xuan; Wang, Guan-Zhong; Fang, Rong-Chuan; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 491; In English; See also 20030068525; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

The structure and the electron-field emission behavior of hydrogenated diamond-like carbon prepared by pulsed laser deposition are investigated. The diamond-like carbon films contain a mixture of sp3-bonds and sp2-bonds, possessing a large electron-field-emission current density [Je=368 mu A/square centimeter at 14V/micrometer], a low turn-on field [E(sub 0)=6V/micrometer] and a low effective work function[phi e=0.0399eV]. The superior electron-field-emission properties of DLC films, as compared with those of diamonds, are ascribed to their nanostructured grains and surface groups such as C-H, which can produce large changes in electron affinity. From Raman spectra, the DLC films possess a diffused D-band resonance peak at 1350 per centimeter and a diffused G-band resonance peak near 1580 per centimeter. Breit-Wigner-Fano and Lorentzian line shape simulations are used to fit the spectra. After the emission, the Raman peak position is shifted due to the presence of nanostructure.
Author
Carbon; Diamond Films; Electron Emission; Hydrogenation; Pulsed Laser Deposition; Raman Spectra

20030068569 Aichi Univ. of Education, Japan
Chemical Vapor Deposition of Diamond Film at High Gas Pressure by Using Pulsed Discharge Plasma
Noda, Mikio; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 573-578; In English; See also 20030068525; Original contains black and white illustrations; No Copyright; Avail: CASI; A02, Hardcopy

Formation of diamond films at gas pressure (Pg) higher than 300 Torr was succeeded by means of a new method of pulsed discharge plasma chemical vapor deposition (CVD). The pulsed discharge was performed by a pulse power supply fabricated

by means of chopping the output of DC power supply with Intelligent Power Module (IPM) and elevating the voltage by a transformer. The switching time of the pulse was shortened to get high discharge beginning voltage, and discharge and non-discharge time in each period of the pulse were adjusted to get stable discharge at high Pg. The deposited films, investigated with scanning electron microscope and Raman spectroscopy, showed that the crystalline quality became superior and the deposition rate increased when Pg increased from 300 to 500 Torr. When a rod-shaped cathode was used against the substrate (anode), the plasma during the deposition was constricted to small diameter with increasing Pg. Emission intensities of H(sub alpha0 and H(sub beta) from the plasma, which were measured with a spectrometer and CCD array sensor, were also increased when Pg increased. By using this method using rod-shaped cathode, the diamond film could be deposited to small area at low substrate temperature.
Author
Diamond Films; Gas Pressure; High Pressure; Fabrication

20030068571 Centre National de la Recherche Scientifique, Strasbourg, France
A DC HF CVD Process to Grow Films of Aligned Carbon Nanotubes: Applications to Field Emission
LeNormand, Francois; Cojocaru; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 554; In English; See also 20030068525; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

A DC HF CVD process to grow films of aligned carbon nanotubes. Applications to field emission. We will describe a new DirectCurrent Hot Filament Catalytic CVD process (DC HF CCVD) that is quite convenient to grow films of aligned carbon nanotubes with a high selectivity. The process is designed in a ultra high vacuum chamber directly connected to a surface analysis chamber provided with XPS AES ELS probes for determination of the carbon nature and surface cleaning and deposition tools (ion beam thermal vacuum evaporation).
Author
Crystal Growth; Carbon Nanotubes; Thin Films; Field Emission

20030068572 Tokyo Inst. of Tech., Yokahama, Japan
Properties of Carbon Deposits Formed by Plasma Spraying of Nanodiamond
Gubarevich, Anna; Odawara, Osamu; Kitamura, Junya; Usuba, Shu; Yokoi, Hiroyuki; Kakudate, Yozo; Tanaka, Akihiro; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 599-604; In English; See also 20030068525; Original contains black and white illustrations; No Copyright; Avail: CASI; A02, Hardcopy

Deposits of carbon nanoparticles based on an onion-like structure were fabricated by a new one-step method, an electromagnetically accelerated plasma spraying (EMAPS) deposition, from detonation nanodiamond powders on stainless steel substrates. The presence of spherical and polyhedral carbon onion particles was confirmed by transmission electron microscopy (TEM) studies. Carbon bonding in virgin powders and synthesized deposits was studied by two-wavelength Raman spectroscopy under excitation by visible (514 nm) and UV (244 nm) irradiation. The transformation of nanodiamonds to closed curved graphitic nanoparticles was explained by intensive heating and electron irradiation of the spraying powder in plasma. Friction measurement of the deposits showed their availability as solid lubricant films.
Author
Carbon; Deposits; Plasma Spraying; Diamonds; Electron Irradiation

20030068573 National Univ. of Singapore, Singapore
Room Temperature Growth of Homogeneous Ultrathin Co Films on 6H-SiC (0001)-6 square root of 3 x 6 square root of 3R30 deg. Surface
Chen, Wei; Xu, Hai; Wee, A. T. S.; Loh, Kian Ping; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 610; In English; See also 20030068525; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

The effect of a periodic template on the nucleation of cobalt clusters was studied by considering the nucleation phenomena of Co atoms on 6H-SiC (0001)- 6 square root of 3 x 6 square root of 3R30 deg. surface. The motivation of our study was to see whether the highly 'porous' reconstruction allows the Co clusters to form regular-sized, periodic nano-islands. The nucleation process was studied by a combination of UHV-STM, RHEED, LEED and XPS. The 6H-SiC (0001)- 6 square toot of 3 x 6 square root of 3R30 deg. reconstructed surface, which contains homogenous honeycombs (2 approx. 3nm in diameter), can confine the Co atoms in the honeycomb and prevent its nucleation into larger clusters during the initial film formation

stage at room temperature. The honeycomb layer also acts as a barrier against cobalt silicide formation. XPS results showed that no cobalt silicide was formed even after the sample was annealed to 1100 C. We propose that this can be a novel method to prepare ferromagnetic nano-metal arrays.
Author
Room Temperature; Honeycomb Structures; Ferromagnetic Materials; Annealing; Crystal Growth

20030068577 Jilin Univ., Changchun, China
The Effect of Annealing on the Field Emission Properties of Amorphous CN(x) Films
Li, J. J.; Jin, Z. S.; Zheng, W. T.; Lu, X. Y.; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 492; In English; See also 20030068525; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

The carbon nitride films deposited by r.f magnetron sputtering in pure N2 discharge were annealed in vacuum up to 900 C. The chemical composition and bonding structure of the films were studied using X-ray photoelectron spectroscopy (XPS), Fourier Transformation Infrared (FTIR). The effects of the thermal annealing on bonding structure and the electron field emission characteristics of CN(sub x) films were investigated. It is found that the sp(sup 2) carbon bonds and N content in CN(sub x) films are closely related to field emission of CN(sub x) films. The results show that thermal annealing treatment cause a great loss of N content and a larger formation of sp2 carbon bonds in CN(sub x) films, which would enhance significantly the field emission properties for the CN(sub x) films. The CN(sub x) films annealed at temperature of 750 C show the optimal electron emission properties. In addition, the correlation between the change in concentration of sp2 carbon bonds in the films induced by annealing and electron emission properties for the CN(sub x) films was discussed.
Author
Amorphous Materials; Annealing; Carbon Nitrides; Field Emission; Thin Films

20030068578 Universal Energy Systems, Inc., Wright-Patterson AFB, OH, USA
The Novel Nucleation Process - An Update: A Method in the Working
Rotter, Shlomo; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 524; In English; See also 20030068525; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

The novel nucleation process (NNP) was introduced publicly 4 years ago, here in Tsukuba, at the ADC/FCT 1999 meeting and has been in the working since then. The main user was Dr. Jim Butler of the Naval Research Laboratory and recently it made its way to AFRL/WPAFB in Dayton Ohio. A few papers appeared already and more are to come where NNP facilitated the use of diamond thin films for various applications. In this paper we will present data that gives some scientific insight of this method. We will present data on the optical properties of the PT (pre treated) film (using Ellipsometric characterization) and EELS data for the material identification of that carbon film. We will show a range of applications that have been opened up by the NNP method. In particular we will show the use of diamond films as an active passivation layer for high voltage SiC Schottky diodes and the use of diamond as the insulation layer on top of a new family of metal matrix composite (MMC) materials for the packaging of high power devices. It will be obvious to the listener that NNP can be used by anyone involved in diamond CVD and especially to those that didn't think diamond could be used for their particular application. NNP has made diamond an easy material to grow and use in ways and means not accessible before NNP. The more people join in the use of NNP, and the more it will be used by many others for their application it will become more obvious that this is the way to grow diamond in most practical cases.
Author
Diamond Films; Nucleation; Optical Properties; Passivity; Insulation; Metal Matrix Composites

20030068579 North Carolina State Univ., Raleigh, NC, USA
Frequency-Dependence of Pulsed Bias-Enhanced Nucleation of Diamond on (100) Silicon
Okuzumi, F.; Sitar, Z.; Wolter, S. D.; Prater, J. T.; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 564-568; In English; See also 20030068525; Original contains black and white illustrations
Contract(s)/Grant(s): DAAG55-98-D-0003; No Copyright; Avail: CASI; A01, Hardcopy

Bias-enhanced nucleation (BEN) is a technique whereby energetic substrate bombardment of ionized species has a profound effect on the promotion of diamond nucleation. Ion sub-plantation and enhanced surface mobilities of carbonaceous species have been proposed to explain the high nucleation densities as well as epitaxial diamond formed on pristine silicon

and SiC. We have studied pulsed BEN to improve upon earlier results of dc-BEN on epitaxial diamond formation and to better understand the dynamics of the plasma sheath region and its effects on bias-enhanced nucleated diamond. Pulsed BEN was performed on (100) silicon substrates using a 17% duty cycle and varying bias frequency in the range of 1 Hz to 2 kHz. We observed a constant proportion of highly oriented diamond of 50% as a function of this relatively low bias frequency range; the transit time of ions through the plasma sheath would be subject to essentially freezing-out only at frequencies on the order of megahertz. A linear increase in bias current with bias frequency, and correspondingly, a linear decrease in the bias duration required to form a quasi-continuous film of diamond was observed.
Author
Frequency Ranges; Diamonds; Bias; Nucleation

20030068580 Louisville Univ., KY, USA
Novel Carbon Nanostructures: Nanopipettes and Nano Nozzles
Bhimarasetti, G.; Mani, R. C.; Sunkara, M. K.; Rajan, K.; Li, X.; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 34-39; In English; See also 20030068525; Original contains black and white illustrations
Contract(s)/Grant(s): NSF CTS-98-76251; No Copyright; Avail: CASI; A02, Hardcopy

We present synthesis of two novel carbon nanostructures in the form of nanopipettes and nanonozzles. The synthesis of both nanopipettes and nanonozzles are highly reproducible. Nanopipettes synthesized using platinum thin film covered, diamond film coated wires at low CH4/H2 ratios, are tapered whiskers, having a shell containing helical graphitic sheets and a hollow core 1-20 nm in diameter throughout the length. Carbon nozzles, synthesized using Ga-Mo alloy film covered substrates at high CH4/H2 have an inner diameter of about 200nm at the base and 3- 4 microns at the end with a constant wall thickness of 30 nm throughout the length. These nozzles were typically filled with Ga at the tip and in some pockets along the length. We hypothesize that the mechanisms involved in the growth of nanopipette and nozzles are quite different than those suggested for the growth of multiwalled carbon nanotubes and other conical structures.
Author
Carbon Nanotubes; Nanostructures (Devices); Nozzles; Pipettes; Morphology; Fluidics

20030068603 National Inst. of Advanced Industrial Science and Technology, Tsukuba, Japan
Nanocrystalline Diamond Film on Large Area Glass Substrate
Tsugawa, K.; Shelby, M.; Yoshikawa, H.; Ishikawa, M.; Liehr, M.; Koga, Y.; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 556; In English; See also 20030068525; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

A high quality, transparent, smooth nanocrystalline diamond film was successfully grown on a Pyrex glass substrate by the microwave plasma chemical vapor deposition (MWPCVD) method. The deposition was carried out using a CH4/H2 plasma maintaining the substrate temperature at as low as 500 C. The films are smooth and reasonably uniform over an area of 30 x 30 sq cm and exhibit strong adhesion to the glass substrate. UV Raman spectroscopy (244 nm excitation wavelength) shows a high quality diamond film by the sharp peak at 1333 /cm. X-ray diffraction analysis indicates that the film consists of nanocrystal diamond, i. e., the crystallites ranged in size from 10 to 20 nm. The transmittance for visible light of a film with a thickness of approximately 1 micron is 55 % at a wavelength of 500 nm and is greater for higher wavelength, reaching 80 % at 766 nm. This high transmittance in the visible light region makes it possible to coat glass windows with diamond film for use in abrasive or other extreme environments, possibly replacing the more expensive materials currently in use.
Author
Borosilicate Glass; Crystallites; Deposition; Diamond Films; Nanocrystals; Substrates

20030068611 Aoyamagakuin Univ., Tokyo, Japan
Large Area Deposition of Heteroepitaxial Diamond Thin Films on Ion-Irradiated Iridium
Sawabe, A.; Okamura, H.; Yamada, T.; Suzuki, K.; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 110; In English; See also 20030068525; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

Heteroepitaxy of diamond is one of the main topics in diamond research society for scientific and industrial point of view. There have been attempted to fabricate heteroepitaxial diamond thin films on foreign substrate such as cubic boron nitride, nickel, silicon, beta-silicon carbide and platinum. Our research group has started to study on heteroepitaxial growth of diamond on iridium/magnesium oxide (MgO) (001) stacking by using two-step dc plasma chemical vapor deposition method

from 1995. Growth area of epitaxial diamond, however, is 3mm in diameter, which is limited by the form and the size of the grid used for pretreatment of ion irradiation. We have developed another pretreatment technique (planar diode type dc plasma) to enlarge the size of ion irradiation area. After this pretreatment, epitaxial diamond can be grown on whole iridium substrate surface with the size of 10x10x0.5 mm. The obtained epitaxial diamond thin film was transparent to visible light with a relative smooth surface. The growth process and the results of characterization will be presented in detail.
Author
Diamond Films; Ion Irradiation; Iridium; Vapor Deposition; Epitaxy

20030068612 National Inst. for Materials Science, Tsukuba, Japan
Electrical Properties of Diamond PN-Junction Devices
Koizumi, S.; Katagiri, M.; Watanabe, K.; Kanda, H.; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 112-113; In English; See also 20030068525; No Copyright; Avail: CASI; A01, Hardcopy

n-Type diamond thin films were successfully formed by optimizing the growth condition of chemical vapor deposited diamond under phosphorus doping to obtain better crystalline perfection. The pn-junction made with stacking film of boron doped (p-type) and the phosphorus doped (n-type) layers has shown good rectification characteristics with the ratio of 10(exp 10) at +/- 10V. The diode characteristics and the behavior of pn-junction interface have been characterized by temperature dependent IV and CV measurements. By forward bias operation, the diode shows ultraviolet light emission at 235 nm that attributes free exciton luminescence. The diode also shows photoelectric response against ultraviolet light with the wavelength shorter than 225 nm that corresponds the bandgap of diamond. It is expected these characteristics of diamond pn-junction will be applied for the next generation opto-electrical devices.
Author
Electrical Properties; Diamond Films; P-N Junctions; Crystal Growth

20030068614 Academy of Sciences (USSR), Moscow, USSR
Fabrication of Very-High-Aspect-Ratio Microchannels in CVD Diamond by a Molding Technique
Ralchenko, V. G.; Givargizov, E. I.; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 540-543; In English; See also 20030068525; Original contains black and white illustrations; No Copyright; Avail: CASI; A01, Hardcopy

The growth of diamond films with built-in microchannels (through holes) of a few microns in diameter with aspect ratio up to 50 has been realized using a molding technique and a special template. The method employs te microwave plasma assisted diamond deposition on (III)Si substrate with regular Si whiskers followed by separation of diamond from the substrate to obtain replica of the original pattern. The holes are hexagonal in cross section, and the hole 'diameter' is almost constant over the whole depth (ca. 100 microns) The position, diameter and depth of the microchannels can be varied in a broad range. Possible applications of perforated diamond film include membranes, drawing dies, heat spreaders with interconnections for electronic circuits, and novel types of diamond-based composites.
Author
Fabrication; High Aspect Ratio; Microchannels; Diamond Films; Molding Materials

20030068618 Nippon Inst. of Tech., Japan
The Joining of Diamond to SiC by Energization Pulse Sintering Method
Tanabe, Jun; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 605-608; In English; See also 20030068525; Original contains black and white illustrations; No Copyright; Avail: CASI; A01, Hardcopy

The application of the energization pulse sintering (EPS) method is comparatively made in low temperature degree and a method of effective diffusion joining between solids in a diamond and the joining of various base materials by a short time. In this study, as materials which were easy to diffuse into diamond and which obtain a bonded SiC was joined with diamond. The junction planes of diamond/SiC confirmed diffusion couple adhesion with all joining conditions by scanning electron microscopy (SEM) and an energy dispersion system (EDS) result after the EPS method. These results showed that grain boundary diffusion and volume diffusion progressed with the volume transport mechanism.
Author
Diamonds; Silicon; Graphite; Diffusion Welding

20030068622 City Univ. of Hong Kong, Kowloon, Hong Kong

Modeling the Deposition of Carbon and Nitrogen Atom/Ions on Wurtzite AIN (001) Surface

Zhang, R. Q.; Zhang, Dongju; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 609; In English; See also 20030068525; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

The bonding behaviors of carbon and nitrogen atom/ions to wurtzite AlN (001) surface have been investigated theoretically using ab initio HF method and the semiempirical AM1 molecular orbital theory. The reactivities of ions were found to be higher on the surface than their neutral atoms based on the frontier molecular orbital theory. The information of the potential energy surfaces calculated for carbon and nitrogen atoms on the AlN substrate suggested that the more ordered and stable Al-N bond can be achieved compared to the Al-C bond. The surface nitride of AlN substrate would improve the quality of the interfacial bonds and hence increase the adhesion between the diamond films and the substrate. Further, the use of the anion beams with an appropriate intensity in ion beam assisted deposition is expected to be more effective for the forming of good ordered interfacial bond than the ionic beam.

Author

Models; Deposition; Carbon; Nitrogen Atoms; Ions; Wurtzite; Surface Layers; Diamond Films

20030068624 China Scientific and Technical Univ., Hofei, China

The Growth of Diamond Films on Porous Anodic Alumina

Wang, Q. T.; Niu, X. B.; Yu, L.; Xu, B.; Liao, Y.; Yu, Q. X.; Wang, G. Z.; Fang, R.C.; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 544; In English; See also 20030068525; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

Chemical vapor deposition (CVD) diamond and Porous anodic alumina (PAA) are important materials that have been attracting great scientific and technological interest. This is due mainly to the novel properties of each these materials and to possible applications in several areas. The searches for the improvement of these materials have naturally been made separately. It will evoke great effect on several future applications if such materials can be structured together. PAA, which is formed by anodization of aluminum in acidic solution, is a typical self-ordered nanohole-array material. Its structure can be described as compact barrier layer directly attaching to aluminum substrate and located over it porous layer, made of a close-packed array of columnar cells, each containing fine, regular, almost cylindrical, parallel-sided, central axial pores. Diamond is one of the most technologically advanced materials available today. It has a unique combination of excellent physical and chemical properties, which makes it ideal for numerous potential applications. Diamond deposition on PAA was carried out in a hot filament chemical vapor deposition (HFCVD) system. PAA was used as substrate and tungsten wire as the filament. The conventional gas mixture of methane and hydrogen was used as the reaction source gas. The effects of deposition parameters on PAA are investigated. The diamond/PAA composite were analyzed by Raman spectroscopy and the morphology was characterized by scanning electron microscopy (SEM), which are commonly used to identify the quality of diamond films. The results indicated that the homogeneous and dense diamond film could be obtained by HFCVD method on PAA.

Author

Crystal Growth; Diamond Films; Vapor Deposition; Aluminum Oxides; Porosity

20030068629 Seki Technotron Corp., Tokyo, Japan

Two-Stage Bias Enhanced Growth of Nanocrystalline Diamond Films

Sharda, Tarun; Soga, Tatsuo; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 579-584; In English; See also 20030068525; Original contains color illustrations; No Copyright; Avail: CASI; A02, Hardcopy

Biased enhanced growth (BEG) is developed as a process to grow nanocrystalline diamond (NCD) films. In the BEG process the diamond nucleation and growth are obtained in a single stage process. Typical conditions, used in this process, are 5 % CH4 in H2 at 30 Torr pressure while heating the substrate in the range of approx. 400 to 700 C. A negative bias of 200 V is applied and the bias current density to the substrate is controlled. The controlled bias current density gives a different set of combination of conditions (bias current density, bias voltage and microwave power) that results in the growth of NCD films composed of grains in the range of 2-30 nm with surface roughness of 20-30 nm at growth rates varying in the range of 0.5 . 2 micron/hr at 1000 W microwave power. In the present study, two-stage BEG is reported. In the first stage a bias of 200 V was applied to the substrate for 30 min followed by growth in the second stage at bias voltages varying in the range of 0-320 V. The films were characterized by Raman spectroscopy and atomic force microscopy. Optical properties (thickness and refractive index) of the films were measured by prism-coupling technique using operating wavelengths of 830 and 1300 nm. Hardness of the films was measured by nano-indentor. Hardness increased and roughness decreased with decreasing the

bias voltage. Films with average hardness of 75-80 GPa, having stress less than 1 GPa, and rms surface roughness of 15 nm have been obtained. Different regimes of growth were observed, respectively, in the bias range up to 100 V and beyond. A growth mechanism for NCD by BEG process, based on the results, is discussed.
Author
Diamond Films; Crystal Growth; Bias; Current Density; Surface Roughness

20030068634 Nagoya Inst. of Tech., Japan
Synthesize of Nanostructure Diamond by Microwave Plasma Chemical Vapor Deposition With Biased Enhanced Nucleation and Hydrogen-Argon Plasma Irradiation
Hayashi, Yasuhiko; Mori, Daisuke; Soga, Tetsuo; Jimbo, Takashi; Proceedings of the Seventh Applied Diamond Conference/ Third Frontier Carbon Technology Joint Conference; August 2003, pp. 585-590; In English; See also 20030068525; Original contains black and white illustrations; No Copyright; Avail: CASI; A02, Hardcopy

The hard (70GPa) and flat (average roughness of 10nm) nanostructure diamond films were synthesized by the combination of two-step substrate bias growth combined with irradiation of Ar-H2 plasma after deposition. Ar-H2 plasma irradiation has been confirmed to increase the hardness and decrease the roughness of films.
Author
Diamond Films; Synthesis (Chemistry); Nanostructure (Characteristics); Microwaves; Vapor Deposition

20030068641 Agency of Industrial Science and Technology, Tsukuba, Japan
Deposition of Cubic Boron Nitride Films by Plasma Based Ion Implantation
Tsuda, Osamu; Watanabe, Toshiya; Suzuki, Masahiro; Ishihara, Masatou; Tanaka, Akihiro; Koga, Yoshinori; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 372-377; In English; See also 20030068525; Original contains color and black and white illustrations; No Copyright; Avail: CASI; A02, Hardcopy

Cubic Boron Nitride (cBN) film depositions were performed by a radio frequency (RF) bias sputtering with a plasma based ion implantation (PBII). Effects of PBII conditions, such as pulse bias voltage and duty ratio, on the nature of the deposited BN films were investigated systematically. It is revealed that the high voltage pulse bias is detrimental to cBN nucleation while cBN growth can proceed with the high voltage pulse biasing. Effects of PBII conditions were also investigated on the compressive stress and the adhesion strength of the deposited films using the two step depositions methods.
Author
Deposition; Boron Nitrides; Metal Films; Plasmas (Physics); Ion Implantation

20030068643 Nippon Inst. of Tech., Japan
Deposition of C-F Thin Films by Sputtering and Their Micro-Mechanical Properties
Wang, M.; Watanabe, S.; Miyake, S.; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 460-464; In English; See also 20030068525; Original contains color and black and white illustrations; No Copyright; Avail: CASI; A01, Hardcopy

Deposition of carbon fluorinated (C-F) and Graphite/PTFE films using RF magnetron sputtering is reported in this article. The films fabricated with forming argon plasma and laying several millimeter size of poly-tetra-fluoroethylene (PTFE) up graphite as targets are characterized using fourier transform infrared spectroscopy, automatic contact angle meter, surface free energy analyzer and surface profile measuring system. Results indicate that there have been C-F bonding and Carbon amorphous structure existing in modified surfaces, the water-repellence of surface modified under different conditions has been increased, and their surface free energy shows lower as comparing with silicon substrate essentially due to C-F bonding existing. In addition, in order to understand the micro-mechanical characteristics of the films in detail, the viscoelastic properties of surface deposited films were studied with atomic force microscope (AFM). Tan of PTFE film is low around 0.1. It could be confirmed that viscoelastic properties of surface are able to be changed and improved by surface modification method.
Author
Carbon; Fabrication; Fluorination; Deposition; Thin Films; Mechanical Properties; Magnetron Sputtering

20030068644 Apollo Diamond, Inc., Sherborn, MA, USA
Characterization and Applications of Single Crystal CVD Diamond
Doering, Patrick J.; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 173; In English; See also 20030068525; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

Recent developments in growth of single crystal diamond by the CVD process has shown that this technique is capable of producing diamond with the highest purity and crystalline perfection on a consistent basis. Further, CVD can produce large single crystals in a cost effective manner. In addition, the CVD technique is suitable for introduction of dopant impurities into the diamond in a controlled manner. This combination of properties indicate that single crystal CVD diamond will enable advanced applications of diamond in the areas of optics and microelectronics, as well as in some of the more traditional applications of diamond. Recent progress in single crystal CVD diamond technology has demonstrated diamond with properties meeting or exceeding the theoretical promise which diamond has presented for the past several decades. In this presentation, we will discuss some of the demonstrated properties of single crystal CVD diamond as well as some of the applications which these properties enable, including new technology areas such as quantum computing.
Author
Single Crystals; Vapor Deposition; Diamonds

20030068648 Centre National de la Recherche Scientifique, Meudon, France
Hydrogen Implanted CVD Boron Doped Monocrystalline Diamond
Ballutaud, D.; Jomard, F.; Rzepka, E.; Boutry-Foreveille, A.; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 291-296; In English; See also 20030068525; No Copyright; Avail: CASI; A02, Hardcopy

Boron doped ([B]=5 x 10(exp 18)/cu cm) monocrystalline [100] diamond films grown by chemical vapour deposition have been implanted with D(sup +) and D(sup +, sub 2) ions at room temperature, with an energy of 50 and 100 keV respectively, and the same atomic deuterium dose of 5 x 10(exp 16)/sq cm. The implanted samples were submitted to successive thermal annealings under ultra-high vacuum. The deuterium profiles were analysed after deuterium implantation and after thermal annealing by Secondary Ion Mass Spectrometry (SIMS). The structural modifications of the buried implanted layer in the diamond film have been analysed by confocal micro-Raman scattering and by Scanning Electron Microscopy. In the case of a deuterium molecular ion implantation, a graphitised and amorphous buried layer may be detected after a 1050 C thermal annealing. While no deuterium diffusion from the implantation buried layer is detected in the film, the SIMS deuterium profile exhibits a depletion at the implantation peak maximum. A blistering of the diamond layer occurs during a 1350 C thermal annealing. This effect is not observed for D(sup +) ionic implantation. In this case, some deuterium diffusion is observed in the film after a 1050 C thermal annealing.
Author
Hydrogen; Ion Implantation; Boron; Depletion; Diamond Films; Doped Crystals

20030068653 Oxford Univ., Oxford, UK
Diamond Electrochemistry
Foord, John; McEvoy, James; Chatterjee, Arnab; Compton, Richard; Marken, Frank; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 178; In English; See also 20030068525; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

Diamond electrodes have attracted great interest in electrochemistry since they offer many advantages over other competitive electrode materials such as glassy carbon. In particular, the high mechanical strength, chemical inertness and biocompatibility of diamond enables its use in hostile conditions or in bio-media which prohibit the use of other electrode materials. A resistance to electrode fouling, low background currents, optical transparency and selective reaction kinetics for particular classes of electrochemical reaction are other important advantages. As a result diamond electrodes are currently being explored for chemical processes such as electrochemical synthesis, and destruction of pollutants, as well as for chemical sensors. The purpose of the present talk will be to describe our work on a range of electrochemical problems using diamond electrodes. Topics to be addressed will include the influence which the nature of the diamond film exerts on the electrochemistry observed, the variations which occur as a result of changes in the surface condition of the diamond electrode, and recent developments in diamond electrochemistry for bio-sensing applications.
Author
Electrochemistry; Diamonds; Electrodes; Electrode Materials

20030068654 Nippon Inst. of Tech., Japan
Anti-Wear Characteristics of Carbon Nitride Thin Films
Watanabe, Shuichi; Miyake, Shojiro; Sutoh, Mieko; Murakawa, Masao; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 466-470; In English; See also 20030068525; Original contains black and white illustrations; No Copyright; Avail: CASI; A01, Hardcopy

The carbon nitride has been proposed theoretically with a possible structure of beta-C3N4, which have replaced Si of beta-Si3N4 with C, by Liu and Cohen in 1989. It was announced that beta-C3N4 had a higher bulk-modulus value than that of diamond. The research in forming C-N compounds has been actively done. Recently, it has been reported that carbon nitride film has showed a unique property, such as a high elastic recovery compared with DLC film, even if a structure of this film was amorphous. In this study, carbon nitride films have been deposited by means of the magnetically enhanced plasma ion-plating equipment. The following two methods of the deposition were investigated. One is the reactive ion-plating which is a reactive evaporation between carbon vapor and nitrogen plasma. The second is a method of an ionized evaporation caused by mixed gas plasma using hydrocarbon and nitrogen gases. Wear performance and deformation energy evaluation of the films were examined by the micro-wear and nano-indentation tests using AFM device having a peculiar transformer head added to the measuring units. Moreover, crystal structure and chemical composition of the film have been analyzed using FT-IR and XPS, respectively. The film formed with the ionized evaporation using C2H2-Ar-N2 gas plasma showed that the hardness becomes harder than that of the film formed with the reactive ion-plating, due to the confirmation of C-N bonding structure from the result of FT-IR and XPS. When the film is formed under CH4-N2 gas plasma, it has been observed that no micro-wear of the film was occurred, resulting in showing good wear resistance. This is understood that the film shows large elastic recovery from the result of the deformation energy evaluation.
Author
Carbon Nitrides; Silicon Nitrides; Thin Films; Wear Inhibitors; Wear Resistance; Deformation

20030068663 Nagoya Univ., Nagoya, Japan
Wear Resistant Behavior of Amorphous Carbon and Carbon Nitride Films Prepared by Shielded Arc Ion Plating
Lee, Kyung Hwang; Ohta, Riichiro; Sugimura, Hiroyuki; Inoue, Yasushi; Takai, Osamu; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 465; In English; See also 20030068525; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

Amorphous carbon (a-C) and carbon nitride (a-CNx) films are promising for many industrial applications owing to their high hardness, wear resistance and solid lubricity. Nowadays, the films attract much attention as biomedical, since the films have chemical and mechanical durabilities in vivo. A CNx frequently shows excellent wear resistance, even though its hardness is not so high in comparison with a-C. Tribological properties of such films have been intensively studied in relation to chemical structures of the films. However, those are not sufficiently elucidated. In this study, a-C and a-CNx films are deposited by shielded arc ion plating (SAIP) with arc current of 60 A, bias voltage in the range from 0 to 500 V and gas pressure of 1 Pa. Mechanical properties of the films including hardness, elastic modulus, recovery, contact stiffness and plastic and elastic deformation energies were measured by a nanoindenter interfaced with an atomic force microscopy (AFM) using a diamond tip (Berkovich type: 65.3 of half angle). Wear resistant behavior of the films was studied by a ball-on-disc tribotester with a load of 5 N and a sliding speed of 100 mm/s. The nanoindenter was also applied to evaluate wear resistant behavior of the films in nm scale. To study chemical structures, the films were analyzed by X-ray photoelectron spectroscopy (XPS) and Raman spectroscopy. We will mainly discuss on the wear resistant behavior in relation to other mechanical properties of a-C and a-CNx films measured based on nanoindentation, as well as the relation of the chemical structures to the tribological properties of the films.
Author
Amorphous Materials; Carbon Nitrides; Diamonds; Ion Plating; Tribology; Wear Resistance; Mechanical Properties; Thin Films

20030068664 National Yun-Lin Univ. of Science and Technology, Touliu, Taiwan, Province of China
The Characteristics of Photo-CVD SiO2 and Its Application in GaN MIS Photodetector
Huang, Bohr-Ran; Lin, Tien-Kun; Su, Yan-Kuin; Chang, Shoou-Jinn; Chiou, Yu-Zung; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 484-489; In English; See also 20030068525; Original contains black and white illustrations
Contract(s)/Grant(s): NSC91-2623-7-006-006; No Copyright; Avail: CASI; A02, Hardcopy

SiO2 insulating layers were deposited onto GaN by photo chemical vapor deposition technique using deuterium (D2) lamp as the excitation source. Physical, chemical and electrical characteristics of the Al/SiO2/GaN metal-insulator-semiconductor (MIS) capacitors were investigated.
Author
Photometers; Silicon Dioxide; Vapor Deposition; Gallium Nitrides; Mis (Semiconductors)

20030068672 Center for Tribology, Inc., Campbell, CA, USA

Multi-Sensor Durability Characterization of Thin Diamond-Like Films

Gitis, N. V.; Xiao, J.; Vinogradov, M.; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 495-499; In English; See also 20030068525; Original contains black and white illustrations; No Copyright; Avail: CASI; A01, Hardcopy

A number of durability tests have been performed on the precision micro-tribometer UMT, using various upper tools like hard ceramic balls, pins, blades and diamond stylus, in such testing modes as uni-directional or reciprocating linear and rotational motions. Multiple test parameters were monitored simultaneously, including servo-controlled vertical load, lateral friction force, high-frequency contact acoustic emission, contact or surface electrical resistance, digital video of the testing zone. The multi-sensing technology allowed for repeatable and comprehensive characterization of the durability of both thick (microns) and thin (nanometers) diamond-like films.

Author

Diamond Films; Durability; Thin Films; Sensors; Multisensor Applications; Friction Measurement

20030068674

Electron Emission from Nano-Structured Diamond Films Deposited on Ion Implanted Si Substrates

Gu, Chagnzhi; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 284; In English; See also 20030068525; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

Electron emission from diamond surface can occur due to its low or even negative electron affinities. Diamond films can show a planar electron emission property at low electric field and be manufactured cheaply. Although a considerable research effort on diamond field emission has been made in decade, there are no obvious mechanisms by which electrons can be transported through the bulk diamond film to the surface and how to obtain stable electron emission. Nano-structured diamond film is one of the most promising materials for active display device because the high grain boundary density in film can submit more emit sites. In this paper we reported that the enhanced and stable electron emission at low applied fields is obtained from nano-structured diamond films deposited on Si substrates implanted by high concentration boron (B) and phosphor (P) ion. 3 micron-thickness nano-structured diamond films were grown on B and P ion implanted Si wafers by a microwave plasma enhanced chemical vapor deposition (MPECVD) process. The average grain size for films deposited on high concentration B and P implanted substrates is 30-200 nm. The electron emission properties from the films on implanted substrates were studies, an enhanced emission property from high concentration implanted samples were concluded. The results show that the high concentration implanted samples have an obvious decreasing in threshold and increasing in current density, particular to the high concentration P implanted sample. This can be attributed to the higher grain boundary density induced by small grain size of nano-structured diamond films deposited on implanted substrates, which permit more emit sites.

Author

Electron Emission; Nanostructure (Characteristics); Diamond Films; Vapor Deposition; Ion Implantation; Silicon

20030068675 National Inst. of Advanced Industrial Science and Technology, Tsukuba, Japan

Diamond-Like Carbon Films Deposited by Plasma-Based Ion Implantation Method

Ishihara, Masatou; Nakamura, Takako; Tanaka, Akihiro; Koga, Yoshinori; Suzuki, Masahiro; Watanabe, Toshiya; Tsuda, Osamu; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 350; In English; See also 20030068525; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

Diamond-like carbon (DLC) films were deposited on Si substrates and high-carbon chromium bearing steel (SUJ2) substrates by a plasma-based ion implantation method using an electron cyclotron resonance (ECR) plasma source with a mirror field and a power supply to apply negative high-voltage pulses and a negative DC bias to the substrate. CH4 gas was used as a carbon source. The plasma was produced from CH4 gas with an ECR power supplier. Before the deposition process of DLC films, carbon ions were implanted into the substrate surface by applying the high-voltage pulses of -10 kV for the formation of a carbon mixing layer. The DLC films with a smooth surface and a low friction coefficient could be formed by applying the negative high-voltage pulses of -2 kV to a substrate with a low duty ratio of 1%. The wear resistance of the DLC films was improved by the formation of the carbon mixing layer. The effect of the mixing layer formed at the interface between the DLC films and the substrate will be discussed in this presentation.

Author

Carbon; Thin Films; Silicon; Chromium Steels; Ion Implantation; Deposition

20030068676 Japan Fine Ceramics Center, Tsukuba, Japan

Synthesis of Carbon Materials Using Abnormal DC Glow Discharge Plasma CVD

Yoshikawa, Hiromichi; Koga, Yoshinori; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 351; In English; See also 20030068525; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

Diamond is a valuable material for the industry because of useful properties including extreme hardness, wide-band optical transparency, and high thermal conductivity. Especially thick and large-scale diamond films can be used in various industrial applications. However, its practical use has been limited due its relatively high cost and scarcity. Microwave plasma CVD using 915MHz is one of the most commonly used methods for synthesizing diamond films. Recently, the plasma transition state from glow discharge to arc discharge has been used for the synthesis of diamond. This system has a greater potential for upward scalability because of its multiple cathode structure. The abnormal glow discharge plasma has the additional advantage of requiring only a very simple plasma generation system using direct current supply units, which results in a lower equipment cost. In the present study, we report the relationship between the obtained carbon materials and the results of optical emission spectroscopy (OES), including images of the first atomic hydrogen Balmer line and the C2(0,0) Swan band.

Author

Diamond Films; Direct Current; Vapor Deposition; Synthesis (Chemistry); Glow Discharges; Plasmas (Physics)

20030068683 Korean Inst. of Science and Technology, Seoul, Korea, Republic of

Selective Nano Copper Dot Formation on Diamond-Like Carbon Film

Kim, Tae-Young; Lee, Churl-Seung; Lee, Seung-Cheol; Lee, Kwang-Ryeol; Oh, Kyu-Hwan; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 511; In English; See also 20030068525; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

We selectively formed nano-scale copper dots on a structure-modulated Diamond-Like Carbon (DLC) films that was obtained by filtered vacuum arc (FVA) process using Si (100) substrate with nano-sized nickel dots on the surface. The structure modulated DLC film has nano-scale graphitic phases embedded in hard DLC matrix. The film exhibits significantly different surface properties that can be used for the selective copper dot formation on the surface. Copper thin film deposited on the structure-modulated film was thermally treated in hydrogen environment. Nano-sized copper dot could be obtained only on the nano-scale graphitic phase. Mechanism of the selective Cu dot formation will be discussed in terms of surface energy and morphology of the surface.

Author

Carbon; Copper; Diamond Films; Nanotechnology; Surface Properties; Morphology

20030068684 Indian Inst. of Tech., Mumbai, India

Self Nucleation of Diamond on Zeolite by Chemical Vapor Deposition Method

Titus, E.; Tyagi, P. K.; Singh, M. K.; Misra, D. S.; Dua, A. K.; Roy, Mainak; Joshi, P. N.; Kasture, M. V.; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 545; In English; See also 20030068525; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

The nucleation stage of diamond in Chemical Vapor Deposition (CVD) is still not properly understood. Several methods were found by trial and error studies to initiate the formation of diamond nuclei on nondiamond substrates, very frequently on single crystal Si wafers. We have obtained first time, diamond nucleation on zeolite substrate with out any pretreatment. Diamond nucleation on zeolite substrate gives some insight into the nucleation mechanism. Depositions were carried out in a hot-filament chemical vapor deposition (HFCVD) apparatus. The HFCVD system was fed with a mixture of methane (0.8%) and balance hydrogen. A series of depositions were done in the pressure range 20-120 torr and at substrate temperature 880 C. The morphologies of the as-deposited films analyzed by scanning electron microscopy (SEM) show isolated diamond grains in the initial nucleation stages, develop into a micro porous films in the next stage and form a continuous film after long time deposition. The grain sizes (20-25microns) were uniform. Raman spectroscopy was used to investigate the crystal morphology, structure and non-diamond impurities in the films deposited at various growth conditions. The Raman spectra taken by focusing laser on single grain showed a single peak of diamond free from other non-diamond features. A single Lorentzian fit to the spectra revealed that the diamond peak is shifted towards higher wave numbers (1335 cm(exp -1)) when compared to natural diamond (1332 cm(exp -1)). This may be due to the compressive stress of diamond. The FWHM of the Raman peak is also quite high (approximately 10.5 cm(exp -1) when compared to natural diamond (2cm(exp-1)). A broad band corresponding to the graphite also appears approximately 1560 cm(exp -1) in addition to the diamond band in the spectrum taken on large area of the sample. The nature of the hydrogen bonding with sp(sup 3) and sp(sup 2) network and the

quantitative analysis were done by Fourier transform infrared (FTIR) spectroscopy. We hope a detailed Transmission Electron Microscopy (TEM) analysis will give more information on nucleation mechanism. A substrate onto which diamond nucleation is not required may enable us to develop the films with uniform grain sizes and it can be used as microfilters. We have used different types of zeolites (HZSM-5, H-beta, and NH4-Y) to study the effect of pore size on nucleation. Effect of pore size and Si/Al ratio on microstructure of diamond films will be reported.
Author
Diamond Films; Nucleation; Vapor Deposition; Zeolites; Microstructure; Methodology

20030068685 Auburn Univ., AL, USA
Nanocrystalline Diamond Films Deposited by Microwave Plasma CVD in Mixtures of Argon and Methane With and Without Hydrogen Additive
Liu, Y. K.; Tzeng, Y.; Tso, P. L.; Lin, I. N.; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 547-552; In English; See also 20030068525; Original contains color illustrations; No Copyright; Avail: CASI; A02, Hardcopy

Nanocrystalline diamond films were deposited on silicon by microwave plasmas in gas mixtures of 1% CH4 + 99% Ar, and 1% CH4 + 5% H2 + 94% Ar. Raman scattering, average surface roughness, surface morphology, and electron field emission characteristics were examined and correlated. Nanodiamond films with average roughness of five to fifteen nanometers were deposited. Very smooth nanodiamond films have been deposited. Electron field emission currents from these nanodiamond films were very low even at an applied electric field of 20 V/ m. Nanodiamond films deposited at a high gas pressure of 200 torr without hydrogen additive were found to emit a higher electron current than other nanodiamond specimens deposited at lower gas pressures or deposited in plasmas with hydrogen additive. Surface roughness including micron and submicron sized particles on the surface of the nanodiamond contributed to the higher electron field emission current. Smooth and micron sized particle-free nanodiamond films deposited in hydrogen-poor plasmas exhibited very small electron field emission current.
Author
Single Crystals; Diamond Films; Microwaves; Plasmas (Physics); Argon; Methane; Additives; Hydrogen Plasma

20030068686 Hong Kong Univ., Hong Kong
Novel Diamond Cone Arrays: Single Crystalline and Nanocrystalline
Wu, Y.; Zhang, W. J.; Chan, C. Y.; Meng, X. M.; Wong, W. K.; Bello, I.; Lifshitz, Y.; Lee, S. T.; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 553; In English; See also 20030068525; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

We have developed a new method for fabricating uniform arrays of single crystal diamond and nanodiamond cones with a very high aspect ratio over large areas using a microwave plasma chemical vapor deposition system. The fabrication of diamond nanocones consists of: 1) deposition of diamond films which serve as base materials and 2) subsequent bias-assisted reactive ion etching in hydrogen plasma. In this two-step process [001].oriented diamond films are converted to very sharp diamond cones with an apical angle of 28 deg. and a tip radius as small as 5 nm. Each cone was identified by TEM as a single crystalline diamond with its [001] axis perpendicular to the substrate surface. Alternatively, when nanodiamond films are used as starting materials for reactive etching by hydrogen plasma, arrays of cones composed of nanodiamond are fabricated. The nanodiamond cones show exceptional electron field emission properties, particularly emission durability and stability compared to single crystalline cones.
Author
Single Crystals; Diamonds; Technology Assessment; Fabrication; Vapor Deposition; Slender Cones

20030068687 Shanghai Jiao Tong Univ., China
Co-Doping of Diamond With Boron and Sulfur
Li, Rong-Bin; Hu, Xiao-Jun; Shen, He-Sheng; He, Xian-Chang; Proceedings of the Seventh Applied Diamond Conference/ Third Frontier Carbon Technology Joint Conference; August 2003, pp. 555; In English; See also 20030068525; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

Sulfur incorporation in diamond was performed by B-S co-doping method via microwave plasma chemical vapour deposition (MPCVD) technique on undoped Si as substrates. Dimethyl disulfide and boron oxide were the doping sources, which were diluted in acetone. Auger electron spectra (AES) confirmed the presence of sulfur in the films. Scanning electron microscopy (SEM), X-ray diffraction (XRD) as well as Raman scattering spectroscopy were employed to characterize the

as-grown films. It was found that limit amounts of boron facilitated sulfur incorporation into diamond. The activation energy of B/S co-doped diamond films is 0.39 eV. SEM observations showed that the crystal quality of these films increases with increasing S incorporation. The observed Fourier transform infrared (FTIR) supported the existence of C, S and B bonding in the films. Even with S incorporation levels of 0.15%, measurements of films resistivity showed that the films had significant high resistance. This might reflect the defects in these polycrystalline films which could act as compensating acceptors, soaking up the donated electrons from the S.
Author
Doped Crystals; Diamonds; Boron Oxides; Sulfur; Vapor Deposition

20030068690 Kochi Univ. of Technology, Tosayamada, Japan
Fabrication of Diamond-Like Carbon Film
Ohashi, Wataru; Yoshimura, Hiroaki; Matsuhisa, Haruka; Aoki, Yusuke; Hatta, Akimitsu; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 490; In English; See also 20030068525; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

We are developing an electron emitter device of a polycrystalline diamond film for cathode and a diamond-like carbon film for insulator. The insulation of the DLC films used for the previous devices was not sufficient. The purpose is to improve the insulation of DLC films. A required performance for the device is below 0.15mA/cm2 at more than 50V. Diamond-Like Carbon films are fabricated by a high frequency plasma CVD method, and the insulation of the films was evaluated. Materials gas of benzene (C6H6) was flowed into a chamber, pressure was 5Pa, HF power was 100W (13.56MHz), and deposition duration was 10 - 60 seconds, the substrates were n-type silicon wafer. The thickness of DLC films was 50nm - 170nm. A coating of gold electrode is vacuum evaporated over both the DLC film and silicon wafer. The current-voltage characteristic between the electrodes was measured. The shottkey characteristic can be ascertained from the I-V curve. The insulation at low voltage was sufficient, however, the leak current increased up to 2.7mA/cm2 at 40V. It is necessary to improve the insulation at the high voltage.
Author
Carbon; Diamond Films; Emitters; Fabrication; High Voltages; Polycrystals

20030068698 Fraunhofer-Inst. fuer Schicht- und Oberflaechentechnik, Brunswick, Germany
Investigation of Large Area HFCVD-Diamond Deposition Processes by Multi-Filament Temperature Measurements
Hoefer, Markus; Schaefer, Lothar; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 539; In English; See also 20030068525; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

Hot-filament chemical vapor deposition (HFCVD) is a technologically important process for depositing polycrystalline diamond films on large areas or three-dimensional substrates. Growth rate and phase purity of the diamond films are essentially determined by the ability of the hot filaments to produce atomic hydrogen which is affected by the temperature and the state of the filaments with respect to carbon incorporations and carbon coverage, respectively. On the other hand, filament temperature measurements in correlation with deposition parameters give evidence of the state of the filaments and the gas phase activation. A motor driven optical pyrometer system has been built up for precise and fully automatized filament temperature measurements in multi-filament arrangements. This device allows to investigate how the state of each filament in a given setup is affected by integral parameters like gas composition, heating power, pressure etc. and also by local changes of the boundary conditions, for instance due to the positioning of the substrates or to inhomogeneities of the gas feeding system. The presented results demonstrate that multi-filament temperature measurement is a powerful tool for monitoring, controlling, and optimizing large area HFCVD processes. Thus it enables the systematic improvement of reproducibility, homogeneity, and quality of the deposited diamond films.
Author
Diamond Films; Temperature Measurement; Three Dimensional Bodies; Substrates

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PHYSICS OF ELEMENTARY PARTICLES AND FIELDS

Includes quantum mechanics; theoretical physics; and statistical mechanics. For related information see also *72 Atomic and Molecular Physics, 73 Nuclear Physics*, and *25 Inorganic, Organic and Physical Chemistry*.

20030068175 Brookhaven National Lab., Upton, NY
Observation of Mechanical Triplet Vibrations in RHCI
Montag, C.; Brennan, M.; Butler, J.; Bonati, R.; Koello, P.; 2002; 8 pp.; In English
Report No.(s): DE2003-805483; BNL-69430; No Copyright; Avail: Department of Energy Information Bridge
Mechanical vibrations of the RHIC IR triplets has been identified as the dominant source of horizontal orbit jitter in the frequency domain below 20 Hz. Results of detailed measurements are be reported to characterize these effects.
NTIS
Atomic Energy Levels; Vibration

20030068181 Brookhaven National Lab., Upton, NY
Neutrino Super-Beam Facility for a Long Baseline Experiment from BNL to Homestake
Kahn, S.; 2002; 8 pp.; In English
Report No.(s): DE2003-805888; BNL-69424; No Copyright; Avail: Department of Energy Information Bridge
An upgrade to the BNL Alternate Gradient Synchrotron (AGS) could produce a very intense proton source at a relatively low cost. Such a proton beam could be used to generate a conventional neutrino beam with a significant flux at large distances from the laboratory. This provides the possibility of a very long baseline neutrino experiment at the Homestake mine. The construction of this facility would allow a program of experiments to study many of the aspects of neutrino oscillations including CP violations. This study examines a 1 MW proton source at BNL and a large 1 megaton detector positioned at the Homestake Mine as the ultimate goal of a staged program to study neutrino oscillations.
NTIS
Accelerators; Neutrino Beams

20030068233 Brookhaven National Lab., Upton, NY
Low Loss Design of the Linac and Accumulator Ring for the Spallation Neutron Source
Raparia, D.; 2002; 8 pp.; In English
Report No.(s): DE2003-807519; BNL-69631; No Copyright; Avail: Department of Energy Information Bridge
The Spallation Neutron Source (SNS) is a second generation pulsed neutron source and is presently in the fourth year of a seven-year construction cycle at Oak Ridge National Laboratory. A collaboration of six national laboratories (ANL, BNL, LANL, LBNL, ORNL, TJNAF) is responsible for the design and construction of the various subsystems. The operation of the facility will begin in 2006 and deliver a 1.0 GeV, 1.4 MW proton beam with pulse length of 650 nanosecond at a repetition rate of 60 Hz, on a liquid mercury target. It consists of an RF volume H(sup -) source of 50 mA peak current at 6% duty; an all electrostatic Low-Energy Beam Transport (LEBT) which also serves as a first stage beam chopper with(+-) 25 ns rise/fall time; a 402.5 MHz, 4-vane Radio-Frequency Quadrupole (RFQ) for acceleration up to 2.5 MeV; a Medium Energy Beam Transport (MEBT) housing a second stage chopper, an adjustable beam halo scraper, and diagnostics devices; a 6-tank Drift Tube Linac (DTL) with permanent magnet quadrupoles up to 87 MeV; an 805 MHz, 4-module, Side Coupled Cavity Linac (CCL) up to 186 MeV; an 805 MHz, superconducting RF (SRF) linac with eleven medium beta (beta)= 0.61) cryo-modules and twelve high beta ((beta)= 0.81) cryo-modules accelerating the beam to the full energy; a High Energy Beam transport (HEBT) for diagnostics, transverse and longitudinal collimation, energy correction, painting and matching; an accumulator ring compressing the 1 GeV, 1 ms pulse to 650 ns for delivery onto the target through a Ring to Target Beam Transport (RTBT) with transverse collimators.
NTIS
Linear Accelerators; Neutron Sources; Spallation

20030068250 Jefferson (Thomas) Lab. Computer Center, Newport News, VA, USA
2Pi Photoproduction from Clas and CB-Elsa the Search for Missing Resonances
Feb. 12, 2003; 14 pp.; In English
Report No.(s): DE2003-807813; No Copyright; Avail: Department of Energy Information Bridge
2 pi-photoproduction is one of the promising reactions to search for baryon resonances that have been predicted but have

not yet been observed. The gamma p yields p pi (sup 0) pi (sup 0) (CB-ELSA) and the gamma p yields p pi (sup +) pi (sup -) (CLAS) data show interesting resonance structures. A partial wave analysis (PWA) has to be done to determine which baryon resonances contribute, what their quantum numbers and their relative couplings to the different accessible p2pi-channels and to the photon are.
NTIS
Photonuclear Reactions; Photoproduction; Baryons; Resonance

20030068613 Turin Univ., Italy
Diamond Microdosimeters and Microdetectors
Manfredotti, C.; Vittone, E.; Fizzotti, F.; Giudice, A. Lo; Paolini, C.; Olivero, P.; Proceedings of the Seventh Applied Diamond Conference/Third Frontier Carbon Technology Joint Conference; August 2003, pp. 120-127; In English; See also 20030068525; Original contains black and white illustrations; No Copyright; Avail: CASI; A02, Hardcopy

Diamond displays many attractive properties which make it an ideal material both for nuclear particle detection and for X-ray dosimetry in medical fields. In fact diamond is radiation hard, tissue equivalent and compatible, and by using CVD (Chemical Vapour Deposition) it can be deposited on different substrates and in different shapes. We have fabricated CVD diamond microdosimeters by depositing thin diamond films (< 20 um thick) on tungsten wires and tips with diameters ranging from 50 um to 300 um. Tips shape can be easily controlled by electrochemical etching the W wire, from emispherical to almost conical one. The electrodes are arranged in a coaxial geometry. These devices can both detect alpha particles, protons and ions with a reasonable energy resolution and with bias voltages of the order of 50 V and can be used as X-ray microdosimeters in small field radiotherapy planning, with an extremely good spatial resolution. We have recorded the performances and the homogeneity of the response of these detectors with proton and alpha particles microbeams by IBICC (Ion Beam Induced Charge Collection) and we have measured the exact dose rate profile of small X-ray beams with an unprecedented spatial resolution.
Author
Microbeams; Dosimeters; Display Devices; X Rays

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ADMINISTRATION AND MANAGEMENT

Includes management planning and research.

20030067989 NASA Kennedy Space Center, Cocoa Beach, FL, USA
SIRTF Finally Aloft: NASA s Final Great Observatory to Peer Deeply into the Infrared Universe
Covault, Craig; Aviation Week and Space Technology; September 1, 2003, pp. 36; In English; Copyright; Avail: Other Sources

The last of NASA's Great Observations, the Space Infrared Telescope Facility (SIRTF), is undergoing checkout 15,000 mi. from Earth this week following launch of the $1.2-billion mission here on board a Boeing Delta II Heavy booster Aug. 25. The SIRTF mission has been 25 years in the making. By using innovative technology and a unique 'Earth-trailing' orbit, the Jet Propulsion Laboratory and Lockheed-Martin were able to reduce mission cost by about $800 million with no loss in expected science or mission life-time.
Derived from text
Checkout; Space Infrared Telescope Facility; Infrared Radiation

20030068168 California Univ., San Diego, La Jolla, CA, USA
The Chemistry of Early Self-Replicating Systems
Bada, Jeffrey L., Principal Investigator; [2003]; 160 pp.; In English
Contract(s)/Grant(s): NAG5-4546; Copyright; Avail: CASI; A08, Hardcopy

The NASA Specialized Center of Research and Training in Exobiology (NSCORT/Exobiology) is a program within the UCSD California Space Institute (Dr. Wolfgang Berger, Director) currently funded by a second 5 year Federal Demonstration Project Grant from NASA. Its specific aims are: 1. The support and training of Postdoctoral, Graduate, and Undergraduate Fellows in Exobiology. 2. The support of research by the Principal Investigators and Fellows in the field of Exobiology. 3. Outreach programs emphasizing the dissemination and exchange of information concerning Exobiology within the scientific community, primary, secondary and college students, and the general public. 4. Host of the 1999 meeting of the International

Society for the Study of the Origin of Life (ISSOL) held at the University of California, San Diego in La Jolla, California, from Sunday, July 11 through Friday, July 16,1999.
Derived from text
Information Dissemination; Exobiology; Biological Evolution

20030068229 NASA Marshall Space Flight Center, Huntsville, AL, USA
International Space Station Laboratory 'Destiny' Hardware Move From MSFC to KSC
Welch, Andrew C.; June 1, 2003; 7 pp.; In English; Society of Logistics Engineers 38th Annual International Conference and Exhibition, 10-14 Aug. 2003, Huntsville, AL, USA; No Copyright; Avail: CASI; A02, Hardcopy

The transportation and handling of space flight hardware always demands the utmost care and planning. This was especially true when it came time to move the International Space Station lab module 'Destiny' from its manufacturing facility at the Marshall Space Flight Center (MSFC) to the launch facility at the Kennedy Space Center in Florida. Good logistics management was the key to the coordination of the large team required to move the lab from the MSFC manufacturing facility 12 miles to the Huntsville International Airport. Overhead signs, power lines, and traffic lights had to be removed, law enforcement had to be coordinated and a major highway had to be completely shut down during the transportation phase of the move. The team responded well, and the move was accomplished on time with no major difficulties.
Author
Logistics Management; Launching Bases; Laboratory Equipment; Industrial Plants; Coordination; Computers

82
DOCUMENTATION AND INFORMATION SCIENCE

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

20030067711 Army Research Lab., Aberdeen Proving Ground, MD
U.S. Army Research Laboratory Gun Tube Erosion Code (ATEC) User's Guide
Conroy, Paul J.; Mar. 2003; 56 pp.; In English
Report No.(s): AD-A414684; ARL-TR-2936; No Copyright; Avail: CASI; A04, Hardcopy

This report documents the US. Army Research laboratory Gun Tube Erosion Code (ATEC) user input as well as output from the code. Instructions for developing an input deck are explicitly provided to assist the user. Each input variable is described, and units are provided where necessary. The appendices include examples of various input decks and an example of the species input file.
DTIC
Guns (Ordnance); Coding

20030067751 Newcastle-upon-Tyne Univ., Newcastle
Distributed Object Middleware to Support Dependable Information Sharing between Organizations
Cook, N.; Shrivastava, S.; Wheater, S.; Feb. 2003; 22 pp.; In English
Report No.(s): PB2003-105174; CS-TR-753; Copyright; Avail: National Technical Information Service (NTIS)

Organizations increasingly use the Internet to offer their own services and to utilize the services of others. This naturally leads to information sharing across organizational boundaries. However, despite the requirement to share information, the autonomy and privacy requirements of organizations must not be compromised. This demands the strict policing of inter-organizational interactions. Thus there is a requirement for dependable mechanisms for information sharing between organizations that do not necessarily trust each other. The paper describes the design of a novel distributed object middleware that guarantees both safety and liveness in this context. The safety property ensures that local policies are not compromised despite failures and/or misbehavior by other parties. The liveness property ensures that, if no party misbehaves, agreed interactions will take place despite a bounded number of temporary network and computer related failures. The paper describes a prototypes implementation with example applications.
NTIS
Organizations; Prototypes; Distributed Processing; Object-Oriented Programming

20030067829 Office of Naval Research, Arlington, VA

Science and Technology Text Mining: Cross-Disciplinary Innovation

Kostoff, Ronald N.; Jun. 20, 2003; 40 pp.; In English

Report No.(s): AD-A414807; No Copyright; Avail: CASI; A03, Hardcopy

Innovation is critical for maintaining competitive advantage in a high tech global economy, especially for organizations or nations that do not possess low cost labor forces. Many studies on innovation attempt to identify endogenous and exogenous variables that impact innovation (Kostoff, l997a), in order to better understand the environment that promotes innovation. The author's recent efforts have focused on developing processes for enhancing innovation that exploit the transference of information and insights among seemingly disparate disciplines. The objective of this report is to describe how innovation can be promoted through the enhancement of discovery by cross-discipline knowledge transfer. The approach developed entails two complementary components - one literature based, the other workshop-based. The literature-based component identifies the science and technology disciplines related to the central theme of interest, the experts in these disciplines, and promising candidate concepts for innovative solutions. These outputs define the agenda and participants for the workshop-based component An example of this combined approach is presented for the theme of Autonomous Flying Systems. The hybrid approach appears to be an excellent vehicle for generating discovery and enabling innovation. However, it requires substantial time and effort in both phases.

DTIC

Information Retrieval; Texts; Information Transfer

20030068094 Air Force Inst. of Tech., Wright-Patterson AFB, OH, USA

Decision Analysis Model for Refreshment of Geobase Imagery: Basis for Investment Strategy

Craig, Matthew S.; Mar. 25, 2003; 151 pp.; In English; Original contains color illustrations

Report No.(s): AD-A415164; AFIT/GEE/ENV/03-05; No Copyright; Avail: CASI; A08, Hardcopy

The USA Air Force is in the process of implementing GeoBase, an initiative to change how geospatial information resources are being acquired, implemented, exploited, and sustained on USAF installations around the world. Using GeoBase increases situational awareness and minimizes decision risk for all installation personnel GeoBase is a geographic information system, using commercial-off-the-shelf software to provide one source for spatial information on an installation. GeoBase uses imagery as one layer of information. The accuracy of the imagery directly impacts the effectiveness of GeoBase. The purpose of this thesis was to develop a decision model to be used in determining imagery refreshment in an installation's GeoBase program. A decision analysis model was developed based on the square footages of changes to the installation. A weighting method process was developed and used to better capture the mission priorities of the installation. This effort resulted in a mathematical equation providing a value representing the amount of change on an installation when compared with its imagery. Results of this effort were tested using information from six installations from three different major commands. This model produces a value comparable across the Air Force and can assist in determining refreshment strategies at each MAJCOM.

DTIC

Spatial Distribution; Information Systems; Decision Theory; Information Management; Geographic Information Systems

20030068157 Air Force Inst. of Tech., Wright-Patterson AFB, OH, USA

Implementing an Information Retrieval and Visualization Framework for Heterogeneous Data Types

Kowalchuk, Andrew J.; Mar. 2003; 83 pp.; In English; Original contains color illustrations

Report No.(s): AD-A415204; AFIT/GCS/ENG/03-09; No Copyright; Avail: CASI; A05, Hardcopy

In today's information focused world, there is no lack of entities focused on information gathering. However, there is still a widespread epidemic of information starvation in the Department of Defense (DoD). This starvation is attributed to the lack of interoperability between information gatherers and information consumers. To alleviate this problem, the DoD has put forth a vision of a Joint Battlespace Infosphere (JBI). This research proposes a framework for sharing and finding resources in a JBI. The framework uses an extensible metadata specification, agent technology, and the Control of Agent Based Systems (CoABS). It provides several tools for publication and subscription of resources, including a visual query wizard and a visualization of the results. This framework and tools provide visual query capability for the heterogeneous resources within the JBI.

DTIC

Information Retrieval; Data Management; Defense Program

83
ECONOMICS AND COST ANALYSIS

Includes cost effectiveness studies.

20030068116 Massachusetts Inst. of Tech., Cambridge, MA, USA
Observations of Departure Processes At Logan Airport to Support the Development of Departure Planning Tools
Idris, Husni R.; Anagnostakis, Ioannis; Delcaire, Bertrand; Hansman, R. John; Clarke, John-Paul; Feron, Eric; Odoni, Amedeo R.; Air Traffic Control Quarterly; 1999; Volume 7, No. 4, pp. 229-257; In English
Contract(s)/Grant(s): NCC2-1147; NAG2-1128; Copyright; Avail: Other Sources

Field observations at Boston Logan International airport and data analyses comparing Logan to other major airports are conducted in order to identify the flow constraints that impede departure operations in an airport system. These observations and the associated analyses are discussed for each of the components of the airport system. It is concluded that the airport systems is a complex interactive queuing system, that the different degrees, and that the runway system is the main flow constraint. The observations and analysis discussed reveal important implications for Departure Planning (DP) tools. The DP tools have competing objectives such as increasing the efficiency of the runway system, reducing delays and environmental impact, and maintaining fairness among all airport users and acceptable workload levels for air traffic controllers. The interactions and dynamics between the different components of the airport system determine how and where in the system the DP tools can reduce the delays and inefficiencies most effectively. Important interactions between the DP tools and other decision-aided tools such as the Center TRACON Automation System (CTAS) and the Surface Movement Advisor (SMA) are also discussed.
Author
Airports; Automatic Control; Data Processing; Runways

88
SPACE SCIENCES (GENERAL)

Includes general research topics related to the natural space sciences. For specific topics in space sciences see *categories 89 through 93*.

20030067922 California Univ., San Diego, La Jolla, CA, USA
Detecting Pyrolysis Products from Bacteria on Mars
Glavin, Daniel; Schubert, Michael; Botta, Oliver; Kminek, Gerhard; Bada, Jeffrey L.; Earth and Planetary Science Letters; 2001; ISSN 0012-821; Volume 185; 8 pp.; In English
Contract(s)/Grant(s): NAG5-4546; Copyright; Avail: Other Sources

A pyrolysis/sublimation technique was developed to isolate volatile amine compounds from a Mars soil analogue inoculated with approx. 10 billion Escherichia coli cells. In this technique, the inoculated soil is heated to 500 C for several seconds at Martian ambient pressure and the sublimate, collected by a cold finger, then analyzed using high performance liquid chromatography. Methylamine and ethylamine, produced from glycine and alanine decarboxylation, were the most abundant amine compounds detected after pyrolysis of the cells. A heating cycle similar to that utilized in our experiment was also used to release organic compounds from the Martian soil in the 1976 Viking gas chromatography/mass spectrometry (GC/MS) pyrolysis experiment. The Viking GC/MS did not detect any organic compounds of Martian origin above a level of a few parts per billion in the Martian surface soil. Although the Viking GC/MS instruments were not specifically designed to search for the presence of living cells on Mars, our experimental results indicate that at the part per billion level, the degradation products generated from several million bacterial cells per gram of Martian soil would not have been detected.
Author
Pyrolysis; Bacteria; Mars Surface; Decarboxylation; Gas Chromatography

20030067975 NASA Marshall Space Flight Center, Huntsville, AL, USA
Science Directorate Publications and Presentations, January 1 - December 31, 2002
Summers, F. G., Compiler; July 2003; 52 pp.; In English
Report No.(s): NASA/TM-2003-212635; M-1082; NAS 1.15:212635; No Copyright; Avail: CASI; A04, Hardcopy

This Technical Memorandum lists the significant publications and presentations of the Science Directorate during the period January 1-December 31, 2002. Entries in the main part of the document are categorized according to NASA Reports (arranged by report number), Open Literature, and Presentations (arranged alphabetically by title). Most of the articles listed

under Open Literature have appeared in refereed professional journals, books, monographs, or conference proceedings. Although many published abstracts are eventually expanded into full papers for publication in scientific and technical journals, they are often sufficiently comprehensive to include the significant results of the research reported. Therefore, published abstracts are listed separately in a subsection under Open Literature.
Author
Astrophysics; Biophysics; Microgravity; Earth Sciences

20030068106 NASA Marshall Space Flight Center, Huntsville, AL, USA
Robust Control for Microgravity Vibration Isolation using Fixed Order, Mixed H2/Mu Design
Whorton, Mark; [2003]; 12 pp.; In English; AIAA Guidance Navigation and Controls Conference, 11-14 Aug. 2003, Austin, TX, USA; Original contains black and white illustrations; No Copyright; Avail: CASI; A03, Hardcopy

Many space-science experiments need an active isolation system to provide a sufficiently quiescent microgravity environment. Modern control methods provide the potential for both high-performance and robust stability in the presence of parametric uncertainties that are characteristic of microgravity vibration isolation systems. While H2 and H(infinity) methods are well established, neither provides the levels of attenuation performance and robust stability in a compensator with low order. Mixed H2/H(infinity), controllers provide a means for maximizing robust stability for a given level of mean-square nominal performance while directly optimizing for controller order constraints. This paper demonstrates the benefit of mixed norm design from the perspective of robustness to parametric uncertainties and controller order for microgravity vibration isolation. A nominal performance metric analogous to the mu measure, for robust stability assessment is also introduced in order to define an acceptable trade space from which different control methodologies can be compared.
Author
Robustness (Mathematics); Hydrogen; Microgravity; Controllers; Vibration Isolators

20030068118 NASA Marshall Space Flight Center, Huntsville, AL, USA
Observations of Counter-Streaming Ion Velocity Distributions in LLBL
Vaisberg, O. L.; Avanonv, L. A.; Smirnov, V. N.; Moore, T. E.; [2003]; 1 pp.; In English; No Copyright; Avail: Other Sources; Abstract Only

We analyze ion velocity distributions observed by Interball-Tail at two LLBL crossings under southward and variable magnetosheath magnetic field. These magnetic conditions lead to highly structured LLBL. D-shape ion velocity distributions were observed within LLBL structures along with other reconnection signatures. Another type of the ion velocity distributions observed within LLBL structures consists of two counter-streaming magnetosheath-type components. We consider two possible scenarios that may lead to development of these counterstreaming ion components: reflection of transmitted magnetosheath ions from the ionosphere and creation of these velocity distributions during formation of the LLBL. We argue that observed counter-streaming component could not be due to ionospheric reflection. The observations of these ion velocity distributions are in favor of the multiple reconnections between magnetosheath and magnetospheric flux tubes.
Author
Ionospheric Propagation; Ion Distribution; Velocity Distribution; Magnetic Fields

20030068132 Jacobs Sverdrup, Huntsville, AL, USA
Experiences with Lab-on-a-chip Technology in Support of NASA Supported Research
Monaco, Lisa; [2003]; 1 pp.; In English; Seminar at NASA Johnson, 18 Aug. 2003, Houston, TX, USA; No Copyright; Avail: Other Sources; Abstract Only

Under the auspices of the Microgravity Sciences and Application Department at Marshall Space Flight Center, we have custom designed and fabricated a lab-on-a-chip (LOC) device, along with Caliper Technologies, for macromolecular crystal growth. The chip has been designed to deliver specified proportions of up-to five various constituents to one of two growth wells (on-chip) for crystal growth. To date, we have grown crystals of thaumatin, glucose isomerase and appoferitin on the chip. The LOC approach offered many advantages that rendered it highly suitable for space based hardware to perform crystal growth on the International Space Station. The same hardware that was utilized for the crystal growth investigations, has also been used by researchers at Glenn Research Center to investigate aspects of microfluidic phenomenon associated with two-phase flow. Additionally, our LOCAD (Lab-on-a-chip Application Development) team has lent its support to Johnson Space Center s Modular Assay for Solar System Exploration project. At present, the LOCAD team is working on the design and build of a unique lab-on-a-chip breadboard control unit whose function is not commercially available. The breadboard can be used as a test bed for the development of chip size labs for environmental monitoring, crew health monitoring assays,

extended flight pharmacological preparations, and many more areas. This unique control unit will be configured for local use and/or remote operation, via the Internet, by other NASA centers. The lab-on-a-chip control unit is being developed with the primary goal of meeting Agency level strategic goals.
Author
Microgravity; Crystal Growth; Chips; Two Phase Flow; Breadboard Models

20030068340 NASA Marshall Space Flight Center, Huntsville, AL, USA
Thaumatin Crystallization Aboard the International Space Station using Liquid-liquid Diffusion in the Enhanced Gaseous Nitrogen Dewar (EGN)
Barnes, Cindy L.; Snell, Edward H.; Kundrot, Craig E.; [2003]; 11 pp.; In English; Copyright; Avail: Other Sources

This paper reports results from the first biological crystal growth experiment on the International Space Station (ISS). Crystals of thaumatin were grown using liquid-liquid diffusion in Tygon tubing transported in the Enhanced Gaseous Nitrogen Dewar (EGN). Different volume ratios and concentrations of protein and precipitant were used to test different adaptations of the vapor-diffusion crystallization recipe to the liquid-liquid diffusion method. The EGN warmed up from 77 to 273K in about 4d, about the same time it took to warm from 273 to 293 K. The temperature within the EGN was 293-297 K for the majority of the experiment. Air gaps that blocked liquid-liquid diffusion formed in the tubes. Nonetheless, crystals were grown. Synchrotron diffraction data collected from the best spacegrown crystal extended to 1.28 A, comparable to previous studies of space-grown thaumatin crystals. The resolution of the best ground-control crystal was only 1.47 A. It is not clear if the difference in diffraction limit arises from factors other than crystal size. Improvements in temperature control and the elimination of air gaps are needed, but the results show that the EGN on the ISS can be used to produce space-grown crystals that diffract to high resolution.
Author
Crystal Growth; Space Processing; Temperature Control; Diffraction; Nitrogen; Proteins

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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.

20030067847 NASA Marshall Space Flight Center, Huntsville, AL, USA
Chandra Observations of the Anomalous X-Ray Pulsar 4U 0142+61
Patel, Sandeep K.; Kouveliotou, Chryssa; Woods, Peter M.; Tennant, Allyn F.; Weisskopf, Martin C.; Finger, Mark H.; Wilson, Colleen A.; Goegues, Ersin; vanderKlis, Michiel; Belloni, Tomaso; The Astrophysical Journal; 10 Apr. 2003; Volume 587, pp. 367-372; In English
Contract(s)/Grant(s): NAG5-9350; MX-0101; GO0-1018X; Copyright; Avail: Other Sources

We present X-ray imaging, timing, and phase-resolved spectroscopy of the anomalous X-ray pulsar 4U 0142+61 using the Chandra X-Ray Observatory. The spectrum is well described by a power-law plus blackbody model with GAMMA = 3.35, kT(sub BB) = 0.458 keV, and N(sub H) = 0.91 x 10(exp 22) per square centimeter; we find no significant evidence for spectral features (0.5-7.0 keV). Time-resolved X-ray spectroscopy shows evidence for evolution in phase in either GAMMA, kT(sub BB), or some combination thereof as a function of pulse phase. We derive a precise X-ray position for the source and determine its spin period, P = 8.68866(30) s. We have detected emission beyond 4 inches from the central source and extending beyond 100 inches, likely due to dust scattering in the interstellar medium.
Author
Pulsars; X Ray Astrophysics Facility; X Ray Imagery; X Ray Astronomy

20030067850 Iowa Univ., Iowa City, IA, USA
Analysis and Modeling of Jovian Radio Emissions Observed by Galileo
Menietti, J. D.; [2003]; 5 pp.; In English
Contract(s)/Grant(s): NAG5-8918; No Copyright; Avail: CASI; A01, Hardcopy

Our studies of Jovian radio emission have resulted in the publication of five papers in refereed journals, with three additional papers in progress. The topics of these papers include the study of narrow-band kilometric radio emission; the apparent control of radio emission by Callisto; quasi-periodic radio emission; hectometric attenuation lanes and their relationship to Io volcanic activity; and modeling of HOM attenuation lanes using ray tracing. A further study of the control

of radio emission by Jovian satellites is currently in progress. Abstracts of each of these papers are contained in the Appendix. A list of the publication titles are also included.
Derived from text
Galileo Spacecraft; Radio Emission; Io; Jupiter Satellites; Astronomical Models

20030067851 Smithsonian Astrophysical Observatory, Cambridge, MA, USA
Feasibility Study of Utilizing Existing Infrared Array Cameras for Daylight Star Tracking on NASA's Ultra Long Duration Balloon (ULDB) Missions
Fazio, Giovanni G.; Tueller, Jack, Technical Monitor; August 2003; 3 pp.; In English
Contract(s)/Grant(s): NAG5-8662; No Copyright; Avail: CASI; A01, Hardcopy

The purpose of this study was to investigate the feasibility of developing a daytime star tracker for ULDB flights using an infrared array camera. This report is an update on our progress to date. A more detailed report is being written describing the use of infrared array cameras as daytime star trackers. The current star tracker camera system consists of an Indigo Systems Merlin InGaAs Infrared camera. This camera has an InGaAs focal plane array (FPA) detector with 320 x 240 pixel of 30 micron x 30 micron size. The detector is sensitive in the wavelength range from 900 to 1680 nm. The integration time per frame can be set between 16 msec and 10 microsec. For use as a star tracker camera, the camera will be operated with 16 msec integration time. The pixel information is digitized with 12-bit resolution and is read into the control computer, a Dell Latitude Cpx laptop computer, via a Bitflow frame-grabber card. As acquisition software we used the program RRCapture. This program is freeware software available on the Internet. The computer also controls all camera functions via a serial connection and a simple terminal program. A GUI-based program, which was delivered with the camera, is not suitable because it allows only limited control of the camera functions. Currently the camera is equipped with a 50 mm lens. Other lenses with focal lengths of 135 mm and 300 mm are available for tests also.
Author
CCD Cameras; Focal Plane Devices; Graphical User Interface; Star Trackers

20030067863 Smithsonian Astrophysical Observatory, Cambridge, MA, USA
RGS Spectroscopy of the Cygnus Loop XA Knot
Gaetz, Terrance J.; Mushotzky, Richard F., Technical Monitor; August 2003; 2 pp.; In English
Contract(s)/Grant(s): NAG5-9978
Report No.(s): Rept-3; No Copyright; Avail: Other Sources; Abstract Only

The observations were performed at the end of April 2002, and the data were received in July 2002. Unfortunately, the observations were badly compromised by high levels of background radiation; one the three observations lost entirely. Two replacement observations were scheduled for November 2002, and were only made available in January of 2003. Consequently, we have had little time to grapple with the unusual data analysis challenges. The search for a postdoctoral fellow has been successfully concluded, and Manami Sasaki began working for us in January 2003. She will be supported in part by these funds, and will be working to help understand these data. Examination of the RGS 'Orders' images indicate the presence of broad emission lines (as expected for the diffuse XA knot). However, examination of the 'Spatial' dispersion/cross-dispersion images indicate that the emission is also broad in the cross-dispersion direction. (As a crosscheck, some of the 'Lockman Hole' datasets were also examined as representative 'sky background' datasets; in these, both types of images are relatively flat (outside the calibration source regions). The quicklook plots of the spectra show the expected O VII and O VIII lines, in addition to a complex around 35 Angstroms; the approx. 35 Angstrom line is likely the C V He-beta line at 34.97 Angstrom, but identifying the additional line(s) will require a more careful reduction of the data. Consequently, there is valuable information to be extracted from these data, but it is complicated by diffuse nature of the emission. Because the angular scale is large, we will have to make use of sky background datasets in order to do the background fitting. A color composite image of OM data in the three UV bands was presented at the 'How does the Galaxy Work?' meeting, and compared to optical and X-ray imaging data. Quantitative analysis will require obtaining the effective bandpasses of the UV filters so that the predominant line and continuum contributions can be identified using plasma shock emission models. In view of the facts that the data were only obtained relatively recently, and the complexity of the data analysis, we request a one year no-cost extension on the grant.
Author
Ultraviolet Astronomy; Ultraviolet Spectroscopy; Emission Spectra; Line Spectra

20030067920 Smithsonian Astrophysical Observatory, Cambridge, MA, USA
Coronal Structures in Cool Stars
Oliversen, Ronald, Technical Monitor; Duprec, Andrea K.; August 2003; 3 pp.; In English
Contract(s)/Grant(s): NAG5-11093; No Copyright; Avail: CASI; A01, Hardcopy

Many papers have been published that further elucidate the structure of coronas in cool stars as determined from EUVE, HST, FUSE, Chandra, and XMM-Newton observations. Highlights of these are summarized including publications during this reporting period and presentations.
Derived from text
Cool Stars; Solar Corona; Astrophysics; Stellar Structure; Astronomical Observatories; Stellar Coronas

20030067931 NASA Marshall Space Flight Center, Huntsville, AL, USA
Probing the Inflow/Out-flow and Accretion Disk of Cyg X-1 in the High State with HETG/Chandra
Feng, Y. X.; Tennant, A. F.; Zhang, S. N.; [2003]; 1 pp.; In English; No Copyright; Avail: Other Sources; Abstract Only

Cyg X- 1 was observed in the high state at the conjunction orbital phase (0) with HETG/Chandra. Strong and asymmetric absorption lines of highly ionized species were detected, such as Fe XXV, Fe XXIV, Fe XXIII, Si XIV, S XVI, Ne X, and etc. In the high state the profile of the absorption lines are composed of an extended red wing and a less extended blue wing. The red wings of higher ionized species are more extended than that of lower ionized species. The detection of these lines provides a way to probe the properties of the flow around the companion and the black hole in Cyg X-1 during the high state. A broad emission feature around 6.5 keV was significantly detected from the both spectra of HETG/Chandra and PCA/RXTE. This feature appears to be symmetric and can be fitted with a Gaussian function rather than the Laor disk line model of fluorescent Fe K$ \alpha$ line from an accretion disk. The implications of these results on the structure of the accretion flow of Cyg X-1 in the high state are discussed.
Author
Accretion Disks; Cygnus Constellation; Line Spectra

20030068295 Smithsonian Astrophysical Observatory, Cambridge, MA, USA
Probing for Pulsars: An XMM Study of the Composite SNRS G327.1-1.1 and CTA1
Slane, Patrick; Mushotzky, Richard F., Technical Monitor; September 2003; 2 pp.; In English
Contract(s)/Grant(s): NAG5-10017; No Copyright; Avail: CASI; A01, Hardcopy

The subject grant is for analysis of XMM data from the supernova remnant CTA1. Our investigation centered on the study of the compact source Rx 50007.0+7302 that, based on our previous observations, appears to be a neutron star powering a wind nebula in the remnant interior. This compact source has also been suggested as the counterpart of the EGRET source 2EG J0008+7307. The analysis of the data from the compact source is complete. We find that the spectrum of the source is well described by a power law with the addition of a soft thermal component that may correspond to emission from hot polar cap regions or to cooling emission from a light element atmosphere over the entire star. There is evidence of extended emission on small spatial scales which may correspond to structure in the underlying synchrotron nebula. Extrapolation of the nonthermal emission component to gamma-ray energies yields a flux that is consistent with that of 2EG J0008+7307, thus strengthening the proposition that there is a gamma-ray emitting pulsar at the center of CTA 1. Our timing studies with the EPIC pn data revealed no evidence for pulsations, however; we set an upper limit of 61% on the pulsed fraction from this source. The results from this study were presented in a poster at the recent IAU Symposium in Sydney, Australia. A paper summarizing these results, entitled 'Xray Observations of the Compact Source in CTA 1' (Slane et al.) has been submitted for publication in the Astrophysical Journal.
Author
Pulsars; Supernova Remnants; Xmm-Newton Telescope; Gamma Ray Sources (Astronomy); Astrophysics

20030068357 Los Alamos National Lab., NM
Infrasound from the El Paso Super-Bolide of October 9, 1997
ReVelle, D. O.; Whitaker, R. W.; Armstrong, W. T.; 1999; 18 pp.; In English
Report No.(s): DE2003-314136; LA-UR-98-2893; No Copyright; Avail: Department of Energy Information Bridge

During the noon hour on October 9, 1997 an extremely bright fireball (approximately -21.5 in stellar magnitude putting it into the class of a super-bolide) was observed over western Texas with visual sightings from as far away as Arizona to northern Mexico and even in northern New Mexico over 00 miles away. This event produced tremendously loud sonic boon reports in the El Paso area. It was also detected locally by 4 seismometers which are part of a network of 5 seismic stations

operated by the University of Texas at El Paso (UTEP). Subsequent investigations of the data from the six infrasound arrays used by LANL (Los Alamos National Laboratory) and operated for the DOE (Department of Energy) as a part of the CTB (Comprehensive Test Ban) Research and Development program for the IMS (International Monitoring System) showed the presence of an infrasonic signal from the proper direction at the correct time for this super-bolide from two of the six arrays. Both the seismic and infrasound recordings indicated that an explosion occurred in the atmosphere at source heights from 28-30 km, having its epicenter slightly to the northeast of Horizon City, Texas.
NTIS
Bolides; Infrasonic Frequencies; Stellar Magnitude

20030068381 Iowa Univ., Iowa City, IA, USA
Modeling Radio Emission Attenuation Lanes Observed by the Galileo and Cassini Spacecraft
Menietti, J. D.; Gurnett, D. A.; Hospodarsky, G. B.; Higgins, C. A.; Kurth, W. S.; Zarka, P.; Planetary and Space Science; 2003; ISSN 0032-0633; Volume 51, pp. 533-540; In English
Contract(s)/Grant(s): JPL-961152; JPL-958779; NAG5-8918; Copyright; Avail: Other Sources

The Cassini radio and plasma wave science (RPWS) investigation is the most advanced plasma wave instrument to visit the Jovian system, measuring electric fields over the frequency range from 1 Hz to 16 MHz with high spectral and temporal resolution. The narrow attenuation lanes in the hectometric emission vary in frequency with system III longitude. The lanes have been modeled in the past assuming a high-latitude cyclotron maser instability source region with emission that is efficiently scattered when the ray path is nearly tangent to the Io L-shell. In the current study we carried out ray tracing of radio emission for multiple frequencies and source regions in a magnetosphere that includes an lo L-shell filled with plasma. The half-width of the density distribution perpendicular to the magnetic field line and the central plasma density of the Io L-shell were fitting parameters. We have used the joint Galileo/Cassini observations at numerous frequencies and radial distances extending to 140 R(sub j) to place constraints on model parameters. The results confirm the suggestion that wave refraction can produce the attenuation lanes. We have also been able to restrict the range of possible hectometric source regions and plasma parameters associated with the density model of the Io L-shell.
Author
Radio Emission; Models; Plasma Waves; Radio Waves

20030068920 NASA Marshall Space Flight Center, Huntsville, AL, USA
Development of a Prototype Nickel Optic for the Constellation-X Hard-X-Ray Telescope
Basso, S.; Bruni, R. J.; Citerio, O.; Engelhaupt, D.; Ghigo, M.; Gorenstien, P.; Mazzoleni, F.; ODell, S. L.; Pareschi, G.; Ramsey, B. D., et al.; [2003]; 1 pp.; In English; Optics for EUV, X-Ray and Gamma-Ray Astronomy, 3-8 Aug. 2003, San Diego, CA, USA; No Copyright; Avail: Other Sources; Abstract Only

The Constellation-X mission, planned for launch in 2011, will feature an array of hard-x ray telescopes with a total collecting area goal of 1500 square centimeters at 40 keV. Various technologies are currently being investigated for the optics of these telescopes including multilayer-coated Eletroformed-Nickel-Replicated (ENR) shells. The attraction of the ENR process is that the resulting full-shell optics are inherently stable and offer the promise of good angular resolution and enhanced instrument sensitivity. The challenge for this process is to meet a relatively tight weight budget with a relatively dense material (rho nickel = 9 grams per cubic centimeters.) To demonstrate the viability of the ENR process we are fabricating a prototype HXT mirror module to be tested against a competing segmented-glass-shell optic. The ENR prototype will consist of 5 shells of diameters from 150 mm to 280 mm and of 426 mm total length. To meet the stringent weight budget for Con-X, the shells will be only 150 micron thick. The innermost of these will be coated with Iridium, while the remainder will be coated with graded-density multilayers. Mandrels for these shells are currently under fabrication (Jan 03), with the first shells scheduled for production in February 03. A tentative date of late Summer has been set for prototype testing. Issues currently being addressed are the control of stresses in the multiplayer coating and ways of mitigating their effects on the figure of the necessarily thin shells. Also, the fabrication, handling and mounting of these shells without inducing permanent figure distortions. A full status report on the prototype optic will be presented along with test results as available.
Author
Constellations; Nickel; Prototypes; X Ray Telescopes; Space Missions; Optics; Fabrication

20030068934 NASA Ames Research Center, Moffett Field, CA, USA
Terrestrial Planet Formation Around Close Binary Stars
Lissauer, Jack J.; Quintana, Elisa V.; [2003]; 1 pp.; In English; DPA Annual Meeting, 3-6 Sep. 2003, Monterey, CA, USA
Contract(s)/Grant(s): 344-30-50-01
Report No.(s): Rept-1; No Copyright; Avail: Other Sources; Abstract Only

Most stars reside in multiple star systems; however, virtually all models of planetary growth have assumed an isolated single star. Numerical simulations of the collapse of molecular cloud cores to form binary stars suggest that disks will form within such systems. Observations indirectly suggest disk material around one or both components within young binary star systems. If planets form at the right places within such circumstellar disks, they can remain in stable orbits within the binary star systems for eons. We are simulating the late stages of growth of terrestrial planets around close binary stars, using a new, ultrafast, symplectic integrator that we have developed for this purpose. The sum of the masses of the two stars is one solar mass, and the initial disk of planetary embryos is the same as that used for simulating the late stages of terrestrial planet growth within our Solar System and in the Alpha Centauri wide binary star system. Giant planets &are included in the simulations, as they are in most simulations of the late stages of terrestrial planet accumulation in our Solar System. When the stars travel on a circular orbit with semimajor axis of up to 0.1 AU about their mutual center of mass, the planetary embryos grow into a system of terrestrial planets that is statistically identical to those formed about single stars, but a larger semimajor axis and/or a significantly eccentric binary orbit can lead to significantly more dynamically hot terrestrial planet systems.
Author
Binary Stars; Terrestrial Planets; Planetary Evolution; Gas Giant Planets; Centaurus Constellation

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ASTROPHYSICS

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

20030067745 Harvard Coll. Observatory, Cambridge, MA, USA
[Activities of Harvard College Observatory]
Dalgarno, A.; Smith, Peter L.; Stark, G.; Yoshino, K.; [2002]; 3 pp.; In English
Contract(s)/Grant(s): NAG5-4348; No Copyright; Avail: CASI; A01, Hardcopy

With support from this grant, we have: 1) Developed techniques for improving wavelengths and f-values for singly and doubly charged ions of the iron group and have improved the accuracy of Fe III wavelengths by an order of magnitude. New Fe II f-values have also resulted from this work. 2) Measured line oscillator strengths and photoabsorption cross sections for UV molecular spectral feature that have been, or could be, used for searches for and detection of molecules in diffuse and translucent interstellar clouds and for determination of molecular column densities there. In addition, we have determined other molecular parameters -- line assignments, wavelengths, and line widths -- that are essential for theoretical descriptions of the abundance, fractionation, and excitation of interstellar molecules and for comparison of predictions with observations. 3) Measured A-values for spin-changing and other weak lines in low-Z ions. When A-values are available, these spectral features are useful for astrophysical plasma density and temperature diagnostics. Such lines are also used in interstellar abundance determinations in cases where the stronger allowed lines are saturated in astronomical spectra. 4) Taken an activist approach to ensuring that, (i), astronomers have ready access to our data, and, (ii), avenues of communication between data users and producers are strengthened.
Author
Ions; Iron; Oscillator Strengths; Photoabsorption; Cross Sections; Ultraviolet Spectra; Line Spectra

20030067817 Texas Univ., Austin, TX, USA
[Activities of Texas University]
Oliversen, R., Technical Monitor; Wills, Beverley J.; Wills, D.; [2003]; 6 pp.; In English
Contract(s)/Grant(s): NAG5-3431; No Copyright; Avail: CASI; A02, Hardcopy

All the principal investigator's current projects investigate aspects of radio-loud, radio-quiet, BAL QSOs, and buried (IRAS-selected) QSOs and the relationships among these different classes, with the aim of probing the nature of accretion onto the massive central black hole - via relativistic jets, X-ray and optical absorption outflows, and the kinematics of the surrounding gas whose emission lines are excited by the accretion continuum.
CASI
Quasars; Deposition; Black Holes (Astronomy)

20030067909 California Inst. of Tech., Pasadena, CA, USA
Balloon-Borne Observations of the Polarization of the Cosmic Microwave Background
[2003]; 2 pp.; In English
Contract(s)/Grant(s): NAG5-9344; No Copyright; Avail: CASI; A01, Hardcopy

This final report is confined to the sub-contract to Caltech, and does not cover work at the PI institution (PI John Ruhl, Case Western Reserve University). In our original proposal, we planned to fly BOOMERANG twice, in the 2000 / 2001 and 2002 / 2003 Austral LDB seasons. The first flight was to have used a newly developed detector technology: the Polarization Sensitive Bolometer (PSB). The second flight was to have used a yet more sophisticated technology: a polarization sensitive, antenna-coupled array (CAMWA). The development of both technologies proceeded more slowly than anticipated. In the end, we were successful in developing the PSB technology to maturity, integrating it into the payload, and flying the payload once during the 2002/2003 Austral season. The payload performed well during this flight, and analysis of the data is in progress. As originally proposed, we have also continued to work on analysis of the data from the 1998 flight, and several publications have resulted. Sufficient progress has been made on the CAMWA technology that we expect to be able to field it into an instrument in 2 to 3 years. However, ground-based telescopes now appear to be a more attractive platform for CMB polarimetry, owing to the longer integration times available. We thus anticipate first implementing CAMWA on a ground-based telescope at South Pole.
Author
Background Radiation; Balloon-Borne Instruments; Polarimetry; Bolometers

20030068032 NASA Goddard Space Flight Center, Greenbelt, MD, USA
Extraterrestrial Amino Acids in Orgueil and Ivuna: Tracing the Parent Body of CI Type Carbonaceous Chondrites
Meyer, Michael, Technical Monitor; Ehrenfreund, Pascale; Glavin, Daniel P.; Bota, Oliver; Cooper, George; Bada, Jeffrey; PNAS; [2001]; Volume 98, No. 5, pp. 2138-2141; In English
Contract(s)/Grant(s): NAG5-4546; Copyright; Avail: Other Sources

Amino acid analyses using HPLC of pristine interior pieces of the CI carbonaceous chondrites Orgueil and Ivuna have found that beta-alanine, glycine, and gamma-amino-n-butyric acid (ABA) are the most abundant amino acids in these two meteorites, with concentrations ranging from approx. 600 to 2,000 parts per billion (ppb). Other alpha-amino acids such as alanine, alpha-ABA, alpha-aminoisobutyric acid (AIB), and isovaline are present only in trace amounts (less than 200 ppb). Carbon isotopic measurements of beta-alanine and glycine and the presence of racemic (D/L 1) alanine and beta-ABA in Orgueil suggest that these amino acids are extraterrestrial in origin. In comparison to the CM carbonaceous chondrites Murchison and Murray, the amino acid composition of the CIs is strikingly distinct, suggesting that these meteorites came from a different type of parent body, possibly an extinct comet, than did the CM carbonaceous chondrites.
Author
Extraterrestrial Matter; Amino Acids; Meteorites; Carbonaceous Chondrites

20030068188 NASA Marshall Space Flight Center, Huntsville, AL, USA
The Peculiar X-ray Transient IGR 16358-4726
Patel, S. K.; Kouveliotou, C.; Tennant, A. F.; Woods, P. M.; King, A.; Ubertini, P.; Winkler, C.; Courvoisier, T.; VanDerKlis, M.; Wachter, S., et al.; [2003]; 1 pp.; In English; No Copyright; Avail: Other Sources; Abstract Only

The new transient IGR 16358-4726 was discovered on 2003 March 19 with INTEGRAL. We detected the source serendipitously during our 2003 March 24 observation of SGR 1627 - 4lwith the Chandra X-ray observatory at the 1.7 x 10(exp -l0) ergs/s sq cm flux level (2-10 keV) with a very high absorption column (N_H = 3.3 x 10(exp 23)/sq cm and a hard power law spectrum of index 0.5(1). We discovered a very strong flux modulation with a period of 5880(50) s and peak-to-peak pulse fraction of 70(6)% (2-10 keV), clearly visible in the X-ray data. The nature of IGR 16358-4726 remains unresolved. The only neutron star systems known with similar spin periods are low luminosity persistent wind-fed pulsars; if this is a spin period, this transient is a new kind of object. If this is an orbital period, then the system could be a compact Low Mass X-ray Binary (LMXB).
Author
Neutron Stars; X Ray Binaries

20030068386 Colorado Univ., Boulder, CO, USA
Services and Support for TOPEX/PODTG
[2003]; 2 pp.; In English
Contract(s)/Grant(s): 1223196; No Copyright; Avail: CASI; A01, Hardcopy

During the TOPEWPoseidon (T/P) mission the Precision Orbit Determination Team Discovered large along track accelerations which were unexpected and of unknown origin. Significant effort was expended in explaining the nature of these accelerations and developing mathematical models for them. It was found that the primary contribution was from unbalanced

solar radiation pressure forces acting on the solar panels. The results of this study and the study recommendations are contained in the attached paper by Kubitschek and Born. Also, during this contract, we investigated techniques for improving the T/P and Jason- 1 precision orbit determination accuracy. The Jason project has set a goal of achieving 1 cm radial orbit accuracy, which is a factor of 2-3 better than currently being achieved for T/P.
Derived from text
Mathematical Models; Orbit Determination; Solar Radiation; Acceleration

20030068443 NASA Marshall Space Flight Center, Huntsville, AL, USA
XTE J1946+274 = GRO J1944+26: An Enigmatic Be/X-Ray Binary
Wilson, Colleen A.; Finger, Mark H.; Coe, M. J.; Negueruela, Ignacio; The Astrophysical Journal; February 20, 2003; Volume 584, pp. 996-1007; In English; Copyright; Avail: Other Sources

XTE J1946+274 = GRO J1944+26 is a 15.8 s Be/X-ray pulsar discovered simultaneously in 1998 September with the Burst and Transient Source Experiment (BATSE) on the Compton Gamma Ray Observatory (CGRO) and the All-Sky Monitor (ASM) on the Rossi X-Ray Timing Explorer (RXTE). Here we present new results from BATSE and RXTE including a pulse timing analysis, spectral analysis, and evidence for an accretion disk. Our pulse timing analysis yielded an orbital period of 169.2 days, a moderate eccentricity 0.33, and implied a mass function of 9.7 solar masses. We observed evidence for an accretion disk, a correlation between measured spin-up rate and flux, which was fitted to obtain a distance estimate of 9.5 +/- 2.9 kpc. XTE J1946+274 remained active from 1998 September to 2001 July, undergoing 13 outbursts that were not locked in orbital phase. Comparing RXTE Proportional Counter Array observations from the initial bright outburst in 1998 and the last pair of outbursts in 2001, we found energy and intensity-dependent pulse profile variations in both outbursts and hardening spectra with increasing intensity during the fainter 2001 outbursts. In 2001 July, optical H alpha observations indicated that a density perturbation appeared in the Be disk as the X-ray outbursts ceased. We propose that the equatorial plane of the Be star is inclined with respect to the orbital plane in this system and that this inclination may be a factor in the unusual outburst behavior of the system.
Author
X Ray Astronomy; Pulsars; Time Measurement; Spectrum Analysis; Accretion Disks; X Ray Binaries

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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*.

20030067700 California Univ., Los Angeles, CA, USA
An IAB-Complex Iron Meteorite Containing Low-Ca Clinopyroxene: Northwest Africa 468 and Its Relationship to Lodranites and Formation by Impact Melting
Rubin, Alan E.; Kallemeyn, Gregory W.; Wasson, John T.; Geochimica et Cosmochimica Acta; 2002; ISSN 0016-7037; Volume 66, No. 20, pp. 3657-3671; In English
Contract(s)/Grant(s): NAG5-4331; Copyright; Avail: Other Sources

Northwest Africa 468 (NWA 468) is a new ungrouped, silicate-rich member of the IAB complex of nonmagmatic iron meteorites. The silicates contain relatively coarse (approx. 300 micron) grains of low-Ca clinopyroxene with polysynthetic twinning and inclined extinction. Low-Ca clinopyroxene is indicative of quenching from high temperatures (either from protoenstatite in a few seconds or high-temperature clinoenstatite in a few hours). It seems likely that NWA 468 formed by impact melting followed by rapid cooling to 5660 C. After the loss of a metal-sulfide melt from the silicates, sulfide was reintroduced, either from impact-mobilized FeS or as an S2 vapor that combined with metallic Fe to produce FeS. The O isotopic composition (Delta (17)O = - 1.39%) indicates that the precursor material of NWA 468 was a metal-rich (e.g., CR) carbonaceous chondrite. Lodranites are similar in bulk chemical and O isotopic composition to the silicates in NWA 468; the MAC 88177 lodranite (which also contains low-Ca clinopyroxene) is close in bulk chemical composition. Both NWA 468 and MAC 88177 have relatively low abundances of rare earth and plagiophile elements. Siderophiles in the metal-rich areas of NWA 468 are similar to those in the MAC 88177 whole rock; both samples contain low Ir and relatively high Fe, Cu, and Se. Most unweathered lodranites contain approx. 20 to 38 wt.% metallic Fe-Ni. These rocks may have formed in an analogous

manner to NWA 468 (i.e., by impact melting of metal-rich carbonaceous chondrite precursors) but with less separation of metal-rich melts from silicates.
Author
Iron Meteorites; Meteoritic Composition; Impact Melts

20030067706 NASA Ames Research Center, Moffett Field, CA, USA
Making Human Exploration of Mars Biologically Reversible
Kay, Chris; [2003]; 1 pp.; In English; Mars Society Conference, 14 Aug. 2003, Eugene, OR, USA
Contract(s)/Grant(s): RTOP 344-53-21-01; No Copyright; Avail: Other Sources; Abstract Only

Mars is interesting because it may have had life in the past and because it may be a place for life in the future. However we are uncertain of the current state of life on Mars. There are at least three possibilities: 1) there is life on Mars that is distinctly different from life on Earth, 2) there is life on Mars that is genetically related to life on Earth, 3) there is no life on Mars. Until we know which of these possibilities is correct we must explore Mars in a way that keeps our options open with respect to future life. I argue that this means that we must explore Mars in a way that is biologically reversible. In this paper I discuss the implications for reversible exploration for human missions to Mars.
Author
Extraterrestrial Life; Mars (Planet); Exobiology; Manned Mars Missions

20030067800 Lawrence Livermore National Lab., Livermore, CA
High-Speed Photon-Counting Camera for the Detection of Extrasolar Planets
Ullom, J. N.; Cunningham, M. F.; Macintosh, B.; Miyazaki, T.; Labov, S. E.; Feb. 07, 2003; 8 pp.; In English
Report No.(s): DE2003-15003349; UCRL-ID-151246; No Copyright; Avail: Department of Energy Information Bridge

Directly observing an extrasolar planet from Earth is challenging because of the relative proximity of the planet to its parent star. Although a large, terrestrial telescope can provide the angular resolution necessary to visually separate the planet from the star, atmospheric turbulence limits the telescope's performance. In addition, the parent star appears much brighter than the planet. To overcome these difficulties, we have developed a high-speed photon-counting camera that is sensitive to individual optical and infrared photons. This camera, which brings together cryogenic sensing elements(Microcalorimeters) and cryogenic digital electronics, will capture a series of images, taking each frame during the short timescale when star glare consists of discrete speckles of light.
NTIS
Extrasolar Planets; Photons; Cameras; Cryogenics

20030067857 NASA Glenn Research Center, Cleveland, OH, USA
Astrobiology: The Case for Venus
Landis, Geoffrey A.; Journal of the British Interplanetary Society; July 2003; Volume 56, No. 7/8, pp. 250-254; In English
Contract(s)/Grant(s): WBS 22-755-60-02
Report No.(s): NASA/TM-2003-212310; E-13895; NAS 1.15:212310; No Copyright; Avail: CASI; A03, Hardcopy

The scientific discipline of astrobiology addresses one of the most fundamental unanswered questions of science: are we alone? Is there life elsewhere in the universe, or is life unique to Earth? The field of astrobiology includes the study of the chemical precursors for life in the solar system; it also includes the search for both presently existing life and fossil signs of previously existing life elsewhere in our own solar system, as well as the search for life outside the solar system. Two of the promising environments within the solar system being currently considered are the surface of the planet Mars, and the hypothesized oceans underneath the ice covering the moon Europa. Both of these environments differ in several key ways from the environments where life is found on Earth; the Mars environment in most places too cold and at too low pressure for liquid water to be stable, and the sub-ice environment of Europa lacking an abundance of free energy in the form of sunlight. The only place in the solar system where we know that life exists today is the Earth. To look for life elsewhere in the solar system, one promising search strategy would be to find and study the environment in the solar system with conditions that are most similar to the environmental conditions where life thrives on the Earth. Specifically, we would like to study a location in the solar system with atmospheric pressure near one bar; temperature in the range where water is liquid, 0 to 100 C; abundant solar energy; and with the primary materials required for life, carbon, oxygen, nitrogen, and hydrogen, present. Other than the surface of the Earth, the only other place where these conditions exist is the atmosphere of Venus, at an altitude of about fifty kilometers above the surface.
Author
Exobiology; Venus (Planet); Solar System; Extraterrestrial Life; Planetary Environments; Fossils; Mars (Planet)

20030067903 AMTI, USA

Deciding Where in the World to Go on Mars and Why

Deardorff, Glenn; Gulick, Virginia; [2003]; 29 pp.; In English; CICT Future Computing and Communications Technologies Course, 29 Apr. 2003, Moffett Field, CA, USA

Contract(s)/Grant(s): DTT559-99-D-00437; NASA Order A-61812-D; Copyright; Avail: CASI; A03, Hardcopy

This viewgraph presentation provides information on the selection process for determining the landing sites for the Mars Exploration Rovers (MERs) launched in 2003. The presentation covers the mission, instruments, and science goals of the MERs, and lists landing site constraints. The profiles of candidate landing sites include images and characteristics for each. Marsoweb, an Internet resource for analyzing data from Mars missions, is also profiled.

CASI

Mission Planning; Mars Missions; Mars Roving Vehicles; Mars Surface; Landing Sites

20030068109 California Univ., San Diego, La Jolla, CA, USA

Leonids: Did They Make it to Earth?

Weigel, A.; Lepland, A.; De, Sasadhar; Marti, K.; Arrhenius, G.; Meteoritics and Planetary Science, Supplement; 2000; Volume 35, No. 5, pp. A168; In English

Contract(s)/Grant(s): NAG5-4546; NAG5-4563; Copyright; Avail: CASI; A01, Hardcopy

On the morning of November 18. 1998, following the spectacular Leonid meteor shower, one of us (S. De) found particles spread over the roof terrace in a residence in Baruipur. a suburb of Calcutta, India. Considering the time and location, these particles possibly derived from the meteor shower, although the fall was not observed. Other particles collected in connection with the Leonid showers in different parts of India proved to be of terrestrial origin.

Author

Leonid Meteoroids; Micrometeorites

20030068180 Johns Hopkins Univ., Laurel, MD, USA

Investigating Atmospheric Effects on Impact Ejecta Morphology: Possible Tool for Determining Past Climate Conditions on Mars?

Appleby, John F.; Barnouin-Jha, Oliver S.; Cheng, Andrew F.; [1999]; 12 pp.; In English

Contract(s)/Grant(s): NAGW-4979; No Copyright; Avail: CASI; A03, Hardcopy

The combined use of impact crater morphology and mechanics provides important information on the physical conditions of both planetary atmospheres and planetary and asteroid surfaces present during crater formation, while an understanding of the rate of crater production on the surface of asteroids provides information of their surface and spin rate evolution. The research performed with support from this project improves our understanding of (1) the mechanics of impact cratering in order to gain insights on the evolution of these physical surface conditions on planets with atmospheres and asteroids, and (2) how impact flux across an asteroid surface may vary due to anisotropic distribution of impactors in the solar system. As part of this project, we have undertaken three studies. In the first study, we investigate atmospheric effects on the morphology of ejecta excavated during a cratering event in order to determine the atmospheric and target conditions from observed crater morphologies. In the second study, we use the physical and morphological consequences of oblique impacts on an asteroid to understand how the asteroid Mathilde (recently imaged by the Near Earth Asteroid Rendezvous - NEAR- spacecraft) could have survived the formation of five giant craters. In a third study, we use a Monte Carlo method to calculate the impact flux on an asteroid given a distribution of impactors on elliptical orbits. In the following section, we present the result obtained from all three studies.

Author

Mars Atmosphere; Atmospheric Effects; Ejecta; Cratering

20030068244 Brown Univ., Providence, RI, USA

SNC Oxygen Fugacity Recorded in Pyroxenes and its Implications for the Oxidation State of the Martian Interior: An Experimental and Analytical Study

McCanta, M. C.; Rutherford, M. J.; [2003]; 8 pp.; In English

Contract(s)/Grant(s): NGT9-63; No Copyright; Avail: CASI; A02, Hardcopy

Knowledge of the oxidation state of a magma is critical as it is one of the parameters which controls the nature and composition of the resulting crystals. In terrestrial magmatic systems, oxygen fugacity (fo2) is known to vary by over nine orders of magnitude. With variations of this magnitude, understanding the compositional differences, phase changes, and

crystallization sequence variations, caused by the magma fo2, is essential in deciphering the origin of all igneous rocks. Magmatic oxidation state is of great importance in that it reflects the degree of oxidation of the source region and can provide insight into magmatic processes, such as metasomatism, degassing, and assimilation, which may have changed them. Carmichael [1991] argues that most magmas are unlikely to have their redox states altered from those of their source region. This assumption allows for estimation of the oxidation state of planetary interiors. Conversely, it is known that the fo2 of the magma can be affected by other processes, which occur outside of the source region and therefore, the oxidation state may record those too. Processes which could overprint source region fugacities include melt dehydrogenation or other volatile loss, water or melt infiltration, or assimilation of oxidized or reduced wallrock. Understanding which of these processes is responsible for the redox state of a magma can provide crucial information regarding igneous processes and other forces active in the region. The composition of the SNC basalts and their widely varying proposed oxidation states raise some interesting questions. Do the SNC meteorites have an oxidized or reduced signature? What was the oxygen fugacity of the SNC source region at the time of melt generation? Is the fugacity calculated for the various SNC samples the fugacity of the magma source region or was it overprinted by later events? Are there different oxidation states in the Martian interior or a single one? This proposal seeks to address all of these questions.
Derived from text
Snc Meteorites; Magma; Mars (Planet); Oxidation-Reduction Reactions; Oxygen; Pyroxenes; Mars Surface

20030068289 Johns Hopkins Univ., Laurel, MD, USA
Giant Craters on Mathilde
Cheng, A. F.; Barnouin-Jha, Olivier S.; Icarus; [1999]; ISSN 0019-1035; Volume 140, pp. 34-48; In English
Contract(s)/Grant(s): NAG5-762; NAGW-4979; Copyright; Avail: Other Sources

Mathilde possesses at least five giant craters, where crater diameters are comparable to the mean radius of the body. Initially, it seems remarkable that this asteroid survived such an onslaught of impacts without disrupting. We consider implications of giant cratering on Mathilde, including effects of oblique impacts. Experimental databases and theory indicate that oblique impacts are (1) less likely to disrupt a target, (2) produce less ejecta relative to a normal impact, and (3) most often do not generate elongated craters. Moreover, oblique impacts reduce crater sizes and ejecta volumes particularly in the case of giant craters, where projectile fragments can miss the target. The morphology of giant craters on Mathilde and the lack of obvious ejecta are consistent with formation by oblique impacts, which could help explain why Mathilde survived. The composition and low density of Mathilde probably indicate a porous and volatile-rich body. Target porosity attenuates shock waves and enhances survival without catastrophic disruption. It is not surprising that several giant craters can be formed on a body without disrupting it. For a realistic projectile population, the probability of making a giant crater on Mathilde is 2.1 to 2.6 times greater than the probability of disruption. The probability of Mathilde surviving the formation of five giant craters is approximately 1 in 5 to 1 in 7.
Author
Asteroids; Craters; Morphology; Projectile Cratering; Space Exploration

20030068413 Scripps Institution of Oceanography, La Jolla, CA, USA
Amino acids in the Tagish Lake Meteorite
Kminek, G.; Botta, O.; Glavin, D. P.; Bada, J. L.; Meteoritics and Planetary Science; January 2002; ISSN 1089-9379; Volume 37, No. 5, pp. 1-9; In English
Contract(s)/Grant(s): NAG5-4546; Copyright; Avail: Other Sources

High-performance liquid chromatography (HPLC) based amino acid analysis of a Tagish Lake meteorite sample recovered 3 months after the meteorite fell to Earth have revealed that the amino acid composition of Tagish Lake is strikingly different from that of the CM and CI carbonaceous chondrites. We found that the Tagish Lake meteorite contains only trace levels of amino acids (total abundance = 880 ppb), which is much lower than the total abundance of amino acids in the CI Orgueil (4100 ppb) and the CM Murchison (16 900 ppb). Because most of the same amino acids found in the Tagish Lake meteorite are also present in the Tagish Lake ice melt water, we conclude that the amino acids detected in the meteorite are terrestrial contamination. We found that the exposure of a sample of Murchison to cold water lead to a substantial reduction over a period of several weeks in the amount of amino acids that are not strongly bound to the meteorite matrix. However, strongly bound amino acids that are extracted by direct HCl hydrolysis are not affected by the leaching process. Thus even if there had been leaching of amino acids from our Tagish Lake meteorite sample during its 3 month residence in Tagish Lake ice and melt water, a Murchison type abundance of endogenous amino acids in the meteorite would have still been readily detectable. The low amino acid content of Tagish Lake indicates that this meteorite originated fiom a different type of parent body than the CM and CI chondrites. The parent body was apparently devoid of the reagents such as aldehyldes/ketones, HCN

and ammonia needed for the effective abiotic synthesis of amino acids. Based on reflectance spectral measurements, Tagish Lake has been associated with P- or D-type asteroids. If the Tagish Lake meteorite was indeed derived fiom these types of parent bodies, our understanding of these primitive asteroids needs to be reevaluated with respect to their potential inventory of biologically important organic compounds.
Author
Synthesis (Chemistry); Murchison Meteorite; Orgueil Meteorite; Amino Acids; Planetary Geology

20030068450 California Univ., San Diego, La Jolla, CA, USA
Relative Amino Acid Concentrations as a Signature for Parent Body Processes of Carbonaceous Chondrites
Botta, Oliver; Glavin, Daniel P.; Kminek, Gerhard; Bada, Jeffrey L.; Origins of Life and Evolution of the Biosphere; 2002; Volume 32, pp. 143-163; In English
Contract(s)/Grant(s): NAG5-4546; Copyright; Avail: Other Sources

Most meteorites are thought to have originated from objects in the asteroid belt. Carbonaceous chondrites, which contain significant amounts of organic carbon including complex organic compounds, have also been suggested to be derived from comets. The current model for the synthesis of organic compounds found in carbonaceous chondrites includes the survival of interstellar organic compounds and the processing of some of these compounds on the meteoritic parent body. The amino acid composition of five CM carbonaceous chondrites, two CIs, one CR, and one CV3 have been measured using hot water extraction-vapor hydrolysis, OPA/NAC derivatization and high-performance liquid chromatography (HPLC). Total amino acid abundances in the bulk meteorites as well as the amino acid concentrations relative to glycine = 1.0 for beta-alanine, alpha-aminoisobutyric acid and D-alanine were determined. Additional data for three Antarctic CM meteorites were obtained from the literature. All CM meteorites analyzed in this study show a complex distribution of amino acids and a high variability in total concentration ranging from approx. 15,300 to approx. 5800 parts per billion (ppb), while the CIs show a total amino acid abundance of approx. 4300 ppb. The relatively (compared to glycine) high AIB content found in all the CMs is a strong indicator that Strecker-cyanohydrin synthesis is the dominant pathway for the formation of amino acids found in these meteorites. The data from the Antarctic CM carbonaceous chondrites are inconsistent with the results from the other CMs, perhaps due to influences from the Antarctic ice that were effective during their residence time. In contrast to CMs, the data from the CI carbonaceous chondrites indicate that the Strecker synthesis was not active on their parent bodies.
Author
Amino Acids; Meteoritic Composition; Carbonaceous Chondrites; Concentration (Composition)

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SPACE RADIATION

Includes cosmic radiation; and inner and outer Earth radiation belts. For biological effects of radiation on plants and animals see *51 Life Sciences*; on human beings see 52 Aerospace Medicine. For theory see *73 Nuclear Physics*.

20030067824 PR and T, Inc., Bonsall, CA, USA
Modeling Charge Collection in Detector Arrays
Hardage, Donna, Technical Monitor; Pickel, J. C.; June 2003; 38 pp.; In English
Contract(s)/Grant(s): NASA Order H-32491-D
Report No.(s): NASA/CR-2003-212504; M-1079; NAS 1.26:212504; No Copyright; Avail: CASI; A03, Hardcopy

A detector array charge collection model has been developed for use as an engineering tool to aid in the design of optical sensor missions for operation in the space radiation environment. This model is an enhancement of the prototype array charge collection model that was developed for the Next Generation Space Telescope (NGST) program. The primary enhancements were accounting for drift-assisted diffusion by Monte Carlo modeling techniques and implementing the modeling approaches in a windows-based code. The modeling is concerned with integrated charge collection within discrete pixels in the focal plane array (FPA), with high fidelity spatial resolution. It is applicable to all detector geometries including monolithc charge coupled devices (CCDs), Active Pixel Sensors (APS) and hybrid FPA geometries based on a detector array bump-bonded to a readout integrated circuit (ROIC).
Author
Arrays; Detectors; Models; Focal Plane Devices

20030068911 NASA Marshall Space Flight Center, Huntsville, AL, USA, Harvard-Smithsonian Center for Astrophysics, Cambridge, MA, USA

Improving the Science Observing Efficiency of the Chandra X-ray Observatory via Chandra Radiation

Virani, Shanil; Schwartz, Daniel; Cameron, Robert; Plucinsky, Paul; ODell, Stephen; Minow, Joseph; Blackwell, William; January 2003; 3 pp.; In English; SPIE Optical Science and Technology 48th Annual Meeting, 3-8 Aug. 2003, San Diego, CA, USA

Contract(s)/Grant(s): NAS8-39073; No Copyright; Avail: Other Sources; Abstract Only

The Chandra X-ray Observatory (CXO), NASA' latest 'Great Observatory', swas launched on July 23, 1999 and reached its final orbit on August 7, 1999. The CXO is in a highly elliptical orbit, approximately 140,000 km x 10,000 km, and has a period of approximately 63.5 hours (approx. 2.65 days). It transits the Earth's Van Allen belts once per orbit during which no science observations can be performed due to the high radiation environment. The Chandra X-ray Observatory Center currently uses the National Space Science Data Center's 'near Earth' AP-8/AE-8 radiation belt model to predict the start and end times of passage through the radiation belts. Our earlier analysis demonstrated that our implementation of the AP-8/AE-8 model (a simple dipole model of the Earth's magnetic field) does not always give sufficiently accurate predictions of the start and end times of transit of the Van Allen belts. This led to a change in our operating procedure whereby we 'padded' the start and end times of transit by 10 kiloseconds (ks) so that ACIS, the primary science instrument on-board Chandra, would not be exposed to the 'fringes' of the Van Allen belts on ingress and egress for any given transit. This additional 20 ks per orbit during which Chandra is unable to perform science observations sums to approximately 3 Ms of 'lost' science time per year and therefore reduces the science observing efficiency of the Observatory. To address the need for a higher fidelity radiation model appropriate for the Chandra orbit, the Chandra Radiation Model (CRM) was developed. The CRM is an ion model for the outer magnetosphere and is based on data from the EPIC/ICS instrument on-board the Geotail satellite as well as data from the CEPPAD/IPS instrument on-board the Polar satellite. With the production and implementation of the CRM, we present the results of a study designed to investigate the science observing time that may be recovered by using the CRM as a function of the additional low-energy proton exposure to ACIS.

Author

Radiation Belts; X Rays; Information Systems; Geomagnetic Tail

20030068937 NASA Marshall Space Flight Center, Huntsville, AL, USA

High Energy Cosmic Ray Electron Spectra measured from the ATIC Balloon Experiment

Chang, J.; Schmidt, W. K. H.; Adams, J. H.; Ahn, H. S.; Bashindzhagyan, G.; Batkov, K. E.; Christl, M.; Fazely, A. R.; Ganel, O.; Gunasingha, R. M., et al.; [2003]; 1 pp.; In English; The 28th International Cosmic Ray Conference, 31 Jul. - 7 Aug. 2003, Tsukuba, Japan; Copyright; Avail: Other Sources; Abstract Only

The Advanced Thin Ionization Calorimeter Balloon Experiment (ATIC) is specifically designed for high energy cosmic ray ion detection. From simulation and a CERN beam test exposure we find that the design consisting of a graphite target and an energy detection device, a totally active calorimeter of BGO scintillator, gives us sufficient information to distinguish electrons from protons up to the TeV energy range. Balloon observations were successfully carried out over Antarctica in both 2000/2001 and 2002/2003 for a total of more than 35 days. This paper presents preliminary results on the spectrum of high energy electrons observed in the first ATIC flight.

Author

Calorimeters; Cosmic Rays; Ionization; High Energy Electrons; Balloon Flight; Electronic Spectra

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GENERAL

Includes aeronautical, astronautical, and space science related histories, biographies, and pertinent reports too broad for categorization; histories or broad overviews of NASA programs such as Apollo, Gemini, and Mercury spacecraft, Earth Resources Technology Satellite (ERTS), and Skylab; NASA appropriations hearings.

20030067758 Nebraska Univ., Omaha, NE, USA

The Aeronautics Education, Research, and Industry Alliance (AERIAL) 2002 Report

Bowen, Brent D.; Fink, Mary M.; Nickerson, Jocelyn S.; November 2002; 65 pp.; In English; See also 20030067759 - 20030067762

Report No.(s): UNOAI-Rept-02-7; No Copyright; Avail: CASI; A04, Hardcopy

This report presents and overview of the Aeronautics Education, Research, and Industry Alliance (AERIAL). It covers the

University of Nebraska's areas of research, and its outreach to students at Native American schools as part of AERIAL. The report contains three papers: 'Airborne Remote Sensing (ARS) for Agricultural Research and Commercialization Application' (White Paper), 'Validated Numerical Models for the Convective Extinction of Fuel Droplets (CEFD)', and 'The Small Aircraft Transportation System (SATS): Research Collaborations with the NASA Langley Research Center'
CASI
University Program; Schools; Students; American Indians

20030067924 NASA, Washington, DC, USA
NASA Performance Plan
[1999]; 48 pp.; In English; No Copyright; Avail: CASI; A03, Hardcopy

The Government Performance and Results Act (GPRA) passed by Congress and signed by the President in 1993 provides a new tool to improve the efficiency of all Federal agencies. The goals of GPRA are to: Improve citizen confidence in Government performance; Improve Federal program management, effectiveness, and public accountability; and Improve congressional decisionmaking on where to commit the Nation's financial and human resources. The Act directs Executive Branch agencies to develop a customer-focused strategic plan that aligns activities with concrete missions and goals. The first plans were submitted in September 1998 as part of the Fiscal Year 1999 (FY99) budget process. These budget submissions were expected to support the goals expressed in the agency strategic plans. The Act also directs agencies to manage and measure results to justify congressional appropriations and authorizations. Six months after the completion of the fiscal year, agencies will report on the degree of success in achieving the goals and evaluation measures defined in the strategic and performance plans. The plans required by GPRA have been submitted to the Office of Management and Budget (OMB) and to Congress. Copies of NASA plans are available from the Office of Policy and Plans at NASA Headquarters and can be accessed on the i nterinet web sites identified in the Appendix.
Author
Project Management; Decision Making; Human Resources; Policies

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