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News Briefs

General Developments

NIST SEEKS PROPOSALS FOR MEASUREMENT GRANTS

NIST is seeking project proposals for its FY 1992 Precision Measurement Grants. The grants are for $30,000 for 1 year and may be renewed for up to 2 additional years. Prospective candidates must submit summaries of their proposed projects and biographical information to NIST by Feb. 1, 1991 to be considered for the current grants, which will run from October 1991 through September 1992. The Precision Measurement Grants are awarded each year to scientists in academic institutions for work in determining values for fundamental constants, investigating related physical phenomena, or developing new, fundamental measurement methods. For information, contact Dr. Barry N. Taylor, Chairman, NIST Precision Measurement Grants Committee, B160 Physics Building, NIST, Gaithersburg, MD 20899, 301/975-4220.

STUDY TO HELP UNDERSTAND BONE DEMINERALIZATION

One of the major problems potentially limiting the long-term habitability of outer space is the "demineralization" of human bone that occurs in a microgravity environment. To help understand this loss of calcium and breakdown of bone tissue, scientists need enriched calcium isotopes that can act as markers to study the calcium metabolism process in the body. Researchers from industry are teaming with NIST scientists to develop and evaluate processes aimed at producing large quantities of a marker isotope—calcium-48—inexpensively. Because calcium-48 is not abundant in nature, the isotope must be produced in the laboratory to acquire the needed amounts. Researchers hope that by using laser light to excite calcium-48 at its resonance frequency, they will be able to extract the isotope from samples. The research will be used by the National Aeronautics and Space Administration in its ongoing investigation of space effects on bone tissue. NIST facilities will be used to study specific applications of analytical techniques such as resonance ionization mass spectrometry, a method NIST used recently to trace the origin of ancient rocks.

BASIC MEMBRANE RESEARCH

The NIST membrane separations program helps to bridge the gap between the fundamental work typical of academic laboratories and the applied research of industrial organizations. NIST conducts both basic and applied research on systems that are riskier in terms of near-term payoff. Current areas of interest include gas separations, pervaporation, ultrafiltration, and general studies which include membrane sorption data for a variety of solutes, external field effects on permeation, and membrane bioreactor concepts. A recent paper, no. 40-90, outlines the programs and facilities and discusses current results and future plans. For a copy, contact Jo Emery, Division 104, NIST, Boulder, CO 80303, 303/497-3237. For more information about the program, contact Dr. John J. Pellegrino, Chemical Engineering Sciences Division, NIST, Boulder, CO 80303, 303/497-3416.

BIBLIOGRAPHY OF ELECTRON SWARM DATA

The NIST/University of Colorado Joint Institute for Laboratory Astrophysics (JILA) has published the third general bibliography on electron swarm data. It is a compilation of references to swarm data published between 1978 and mid-1989. An electron swarm is a cloud of electrons in a neutral gas under conditions such that the dominant interactions are the collisions between the electrons and

the gas atoms or molecules. Measurements include drift velocities, diffusion coefficients, rates of growth of electron density due to ionization, electron loss rates due to recombination or attachment, and the rates of excitation of the various atomic or molecular energy levels. The most important application of electron swarm data is in deriving cross sections for low energy electron impact on atoms and molecules. A Bibliography of Electron Swarm Data, 1978-1989, is available from the JILA Atomic Collision Data Center, University of Colorado, Boulder, CO 80309.

MORE EFFICIENT ROUTE DEVELOPED TO LOW-SHRINKAGE POLYMERS

A simple method has been developed by NIST scientists to produce a new class of difunctional monomers that efficiently cyclopolymerize to yield polymers with improved properties, particularly low shrinkage. Investigations have shown how the chemical composition of the monomers may be varied to control the melting temperature and molecular weight of the monomer as well as the crosslink density and glass transition temperature of the resulting polymer.

The cyclopolymers exhibit more complete polymerization and a reduced degree of polymerization shrinkage compared with conventional diacrylate-based polymeric materials. Other properties, including high-glass transition temperatures, excellent hydrolytic stability and improved processibility, make these monomers attractive for a wide range of applications.

An evaluation of the new cyclopolymerizable monomers as dental composite filling materials has demonstrated improved dimensional stability, hardness, and strength.

The same chemistry can supply multifunctional oligomers capable of several discrete cyclopolymerizations per chain to produce highly crosslinked polymers. A similar reaction also has been exploited to yield highly fluorinated functional monomers. These novel monomers can form soluble or crosslinked polymers which are extremely hydrophobic and solvent resistant. In contrast, the dicarboxylic acid derivative of the monomer provides a water soluble monomer/polymer system that may be useful in adhesive applications.

WEAR MECHANISMS IN COAL-FUELED DIESEL ENGINES

Diesel engines capable of operating directly on pulverized coal are currently under development by U.S. industry. Improved processes for the production of highly refined coal-fuels, the great abundance of coal, and diminishing supplies of crude oil are strong incentives for this effort. However, commercial success will require finding solutions to a number of technical problems, such as the high rate of wear of piston rings and cylinder liners. Researchers at NIST under the sponsorship of DOE are conducting a program to develop an understanding of the processes that are responsible for the high rates of wear. The primary mechanism appears to be that of abrasive wear due to the presence of mineral particles, such as silicates, in the coal combustion products. Although silicates can cause significant abrasion of conventional chromium plating and cast iron materials used in diesel engines, they are far less damaging to hard ceramics and ceramic-metal composite materials. Results of this program will assist in the selection and development of improved engine component materials to resist wear in the harsh coal-fuel environment. Indeed, engine developers are currently focusing on the use of such materials, probably in the form of coatings, to protect cylinder liners and piston rings from wear.

FIRST SEMPA IMAGES OF MAGNETO-OPTICAL RECORDING MEDIA

Magneto-optical disk drives are just now entering the personal computer and workstation market. This technology uses a laser and an alternating magnetic field to read and write onto a ferrimagnetic TbFeCo alloy film coating on a rotating disk. The storage density is very high, allowing over 600 megabytes to be stored in a package comparable in size to a floppy disk. However, despite intensive research, the basic magnetic domain structure of these films is poorly understood. The domains are unusually small (about 1 μm^2) and have very weak saturation magnetization.

NIST scientists were able to measure the surface magnetic microstructure of written domains in several TbFeCo alloys using scanning electron microscopy with polarization analysis (SEMPA). SEMPA, developed by NIST researchers, is capable of resolving magnetic microstructure with 50-nm spatial resolution. The instrument employs a scanning electron microscope to excite secondary electrons at surfaces. Analysis of the spin-polarization of the emitted secondary electrons generates high-resolution maps of surface magnetization.

The observations of written domains in TbFeCo alloys are the first SEMPA measurements in ferri-

magnetic systems and the first demonstration that the polarized secondary-electron cascade, which underlies the magnetic contrast in SEMPA, is dominated by the 3-*d* valence electrons from the transition metals in these alloys. The quality of the thermomagnetically written bits was investigated as a function of alloy composition and applied switching field intensity. The SEMPA measurements revealed that the demagnetizing field, which affects the nucleation and growth of domains, was the most important parameter for ensuring the regularity of the written bits.

SECURE DATA NETWORK SYSTEM (SDNS) REPORTS PUBLISHED

Three new NIST publications present the results of Phase I of the SDNS, a government/industry project sponsored by the National Security Agency (NSA). The SDNS project was initiated by NSA to investigate methods of implementing security in a distributed computer network. The results of the project consist of a set of specifications that include security services, protocols, and mechanisms for protecting user data in networks that are based on the open systems interconnection computer network model.

NIST is publishing the documents to make them broadly available and to advance their consideration as voluntary industry standards. NISTIR 90-4250, Secure Data Network System (SDNS) Network, Transport, and Message Security Protocols, includes four security protocol documents. NISTIR 90-4259, Secure Data Network System (SDNS) Access Control Documents, presents access control concepts, while key management protocols are contained in NISTIR 90-4262, Secure Data Network System (SDNS) Key Management Documents.

REVISION TO FIPS 120, GRAPHICAL KERNEL SYSTEM (GKS), PROPOSED

A revision has been proposed to FIPS 120, graphical kernel system (GKS), to add a requirement for validation of GKS implementations acquired by federal agencies. The standard adopts the American National Standard Graphical Kernel System (ANS GKS), which consists of four parts: the basic functions for computer graphics programming (ANSI X3.124-1985); the FORTRAN programming language binding for GKS (ANSI X3.124-2-1988); the Pascal programming language binding for GKS (ANSI X3.124-2-1988); and the Ada programming language binding for GKS (ANSI X3.124.3-1988). ANS GKS specifies a library of subroutines which permit the production and manipulation of two-dimensional pictures, enhancing the portability of graphics applications between different computer systems.

FIPS 100 BEING REVISED

NIST has proposed a revision to FIPS 100, interface between data terminal equipment (DTE) and data circuit-terminating equipment (DCE) for operation with packet-switched data networks (PSDNs), or between two DTEs, by dedicated circuit, and federal standard (FED-STD) 1041. The proposed revision specifies the interface between DTE such as ADP equipment and telecommunication system terminal equipment, and DCE for operation in the packet mode on PSDNs, or between two DTEs, by dedicated circuit.

The revised standard will adopt for federal agency use American National Standard (ANSI) X3.100-1989, which in turn adopts CCITT Recommendation X.25-1988, ISO 7776-1989, and ISO 8208-1987. After comments received from industry and the public have been considered, the revised FIPS will be forwarded to the Secretary of Commerce for review and approval.

FIPS FOR PROGRAMMING LANGUAGE C PROPOSED

NIST has proposed a new FIPS for programming language C, which will adopt American National Standard (ANSI) X3.159-1989. The standard specifies the form and establishes the interpretation of programs written in the C programming language. The proposed FIPS would promote portability of C programs for federal agency use on a variety of data processing systems.

AMERICAN SOCIETY FOR METALS ADOPTS NIST-DEVELOPED SOFTWARE TO FURTHER ITS PHASE DIAGRAM PUBLICATIONS

The NIST-developed software FHAZE will be used for ASM's major programs in phase diagram production. ASM has acquired computer workstations and staff to digitize data for 4,700 phase diagram graphs. The resultant high-quality graphics will be published in a second edition of Binary Alloy Phase Diagrams. Upon completion of that publication, one of the workstations will continue its role for digitizing graphs for the Journal of Phase Equilibria and the ASM Monograph series on alloy phase diagrams.

FHAZE incorporates the modern graphics capabilities of the GKS graphics standard for graphics terminals which can selectively update a screen,

and LISP-based programming methods for representing the complex graphical data structures required for metal alloy phase diagrams. The program has produced publication quality graphic output for phase diagrams in a wide range of styles and provided a means for transcribing, fitting, viewing, and organizing the data from a fundamental, i.e., thermodynamic point of view. The FHAZE software was used by ASM and NIST to produce phase diagrams for approximately 1,850 alloy systems in the two-volume first edition of Binary Alloy Phase Diagrams. At the time of its publication in 1987, it was world's most complete source of reliable data on alloy phase diagrams.

FREQUENCY STABILIZATION OF ERBIUM FIBER LASER OFFERS POTENTIAL FOR WAVELENGTH STANDARD

A NIST scientist has for the first time successfully stabilized in frequency the output from an erbium-doped optical-fiber laser that can be tuned to a single frequency over the range 1.52 to 1.57 μm, and that has an unstabilized linewidth of less than 1 MHz. These characteristics offer considerable potential for use as a wavelength standard for optical communication systems, needed especially for coherent systems and those using frequency-division multiplexing. The only laser line available previously in this wavelength range is a transition (untunable) at 1.52 μm in helium-neon. To remove long-term frequency drifts, the scientist stabilized the laser to an absorption line of acetylene near 1.53 μm by arranging to change the laser cavity length electronically in response to an error signal derived from the acetylene absorption.

NIST WORK LEADS TO ADOPTION OF THREE ASTM STANDARDS ON ELECTROMIGRATION MEASUREMENTS

NIST collaborative efforts with the semiconductor industry have resulted in the adoption of three electromigration-related standards by ASTM (formerly American Society for Testing and Materials). A NIST scientist was the originator and prime mover of these standards, which also recently have been adopted by the Electronics Industries Association Joint Electron Device Engineering Council (EIA/JEDEC) Committee 14.2 on Wafer Reliability for its wafer-level electromigration stress tests. These standards are: F 1260-89, Standard Test Method for Estimating Electromigration Median Time-to-Failure and Sigma of Integrated Circuit Metallizations; F 1259-89, Standard Guide for Design of Flat, Straight-Line Test Structures for Detecting Metallization Open-Circuit or Resistance-Increase Failure Due to Electromigration; and F 1261-89, Standard Test Method for Determining the Average Width and Cross-Sectional Area of a Straight, Thin-Film Metal Line. In response to increasing industry concerns about failures resulting from electromigration, the standards provide procedures for conducting electromigration stress tests and for designing test structures to support these tests and promote the reproducibility of the characterization of metallization interconnects in very-large-scale integrated circuits. The standards also serve to reduce disagreements between vendor and user, enhance confidence in test data among workers in the field, and lead to more effective research and development for reliability and performance improvements.

NEW VIDEO CAN HELP SAVE ENERGY AND DOLLARS

Energy-efficient buildings make dollars and sense. But tight operating and construction budgets often force tough decisions to be made on energy-conservation projects. A new video training program developed by NIST gives building professionals the basic tools needed to evaluate the cost-effectiveness of these decisions. The 1-h video is the first in a series NIST is producing for the U.S. Department of Energy (DOE). NIST economists and a DOE engineer explain basic concepts of life-cycle cost analysis and demonstrate problem-solving techniques and computer programs that can be used to calculate a building's energy consumption and the life-cycle costs of alternative designs and systems. By the end of the video, the viewer should be able to solve simple, but realistic, problems. A workbook accompanies the video. The videotape, titled Least-Cost Energy Decisions: An Introduction to Life-Cycle Cost Analysis, is available from Video Transfer Inc., 5709-B Arundel Ave., Rockville, MD 20852, 301/881-0270. VHS format is $19. Contact Video Transfer Inc. for prices on other formats.

CHARACTERIZING CLOCKS AND OSCILLATORS

Managers of calibration laboratories in private industry, universities, the military, and government agencies will be interested in a new publication from NIST. Characterization of Clocks and Oscillators (NIST TN 1337) is a collection of published papers designed as a reference for those involved in

characterizing and specifying high-performance clocks and oscillators. It is an interim replacement for NBS Monograph 140, Time and Frequency: Theory and Fundamentals, which was published in 1974. The current volume includes tutorial papers, papers on standards and definitions, and papers detailing specific measurement and analysis techniques (with corrections and notes indicating current recommended IEEE notation). Topics covered include properties of signal sources, phase noise measurements, standard terminology, stability measurement, and biases and variances. TN 1337 is available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402. Order by stock no. 003-003-03019-8 for $17 prepaid.

ATMOSPHERIC ATTENUATION MEASUREMENTS STUDIED

While developing measurement methods to determine the performance of 7- to 10-GHz satellite Earth terminals, including such parameters as gain, G/T, and satellite effective isotropic radiated power, NIST researchers examined methods to correct for atmospheric attenuation effects. At 7 to 10 GHz, the principal atmospheric effects on a radio signal are the attenuations due to absorption by oxygen and water vapor molecules, and to scattering by particles of water (rain, clouds, and fog). X-Band Atmospheric Attenuation for an Earth Terminal Measurement System (NISTIR 89-3918) provides an overview of various methods to determine atmospheric attenuation (sky brightness tipping-curve method, radio source extinction curve method, and dual frequency radiometer technique) and analyzes the errors of these methods. Copies may be ordered from the National Technical Information Service, Springfield, VA 22161. Order by PB #90-100736 for $13.95 prepaid.

ELECTROMAGNETIC PROPERTIES OF SUPERCONDUCTORS

Designers and builders of high-energy physics magnets (including those for the Superconducting Super Collider) and of nuclear magnetic resonance instruments need data on the performance of superconductors and high-permeability steels. NIST has studied the effects on the superconductor critical current of mechanical loading and of the deformation resulting from fabrication. NIST also has evaluated the magnetic properties of several types of steel alloys used in these magnets and instruments. A report, Electromechanical Properties of Superconductors for High Energy Physics Applications, Part II (NISTIR 89-3912), describing NIST's findings is available from the National Technical Information Service, Springfield, VA 22161. Order by PB #90-163627 for $23. An earlier report, Electromagnetic Properties of Superconductors for High Energy Physics Applications (NISTIR 86-3061) can be ordered by PB #87-165585 for $23 prepaid.

MEASUREMENT NEEDS FOR NEW TECHNOLOGIES IN ELECTRONICS

New technologies and products based on microwaves, superconductors, lightwaves, advanced imaging technology, semiconductors, and magnetics share a common need now: more sensitive and accurate measurement techniques. A 192-page report now available from NIST devotes a chapter to the measurement role in each of eight key emerging technologies. Measurement is important to the electronics industry because it affects every phase of product realization, from research and development to manufacturing, marketing, and use. Bad measurement means wasted time and defective products. NIST managers hope the emerging technologies report will help define the research direction of measurement support for these technologies and will foster greater cooperation between NIST and industry. To receive a copy of Emerging Technologies in Electronics . . . and Their Measurement Needs: Second Edition (NISTIR 90-4260), contact the Center for Electronics and Electrical Engineering, B358 Metrology Building, NIST, Gaithersburg, MD 20899, 301/975-2220.

ELECTRICAL ENGINEERING/ELECTRONICS BULLETIN AVAILABLE

NIST measurement programs in semiconductor technology, signals and systems, electrical power, and electromagnetic interference are described in a publication now available. The Technical Progress Bulletin covers NIST's Center for Electronics and Electrical Engineering and its programs, which provide national reference standards, measurement methods, supporting theory and data, and traceability to national standards. Included are abstracts of papers and published works arranged by topic (with phone numbers of contacts). Semiconductor subjects covered include silicon materials, dimensional metrology, photodetectors, and device physics and modeling. Also included are sections on waveform, antenna, cryoelectronic, electro-optic, optical fiber, and power systems metrology. To receive the most recent issue or to be placed on

the mailing list, write to or call (stating your professional affiliation or technical interest): Technical Progress Bulletin, Center for Electronics and Electrical Engineering, B358 Metrology Building, NIST, Gaithersburg, MD 20899, 301/975-2220.

NIST EXPANDS SECURITY BULLETIN BOARD

The NIST Computer Security Bulletin Board has been expanded making it easier to access the information stored in the system. In operation since October 1989, this electronic bulletin board contains a variety of information dealing with computer security, including bibliographies of relevant publications and listings of security-related seminars and conferences. In addition, the system contains information issued by NIST and others concerning computer security incidents, such as computer virus attacks. NIST also will use the bulletin board to disseminate information about future incidents. A standard ASCII terminal or a personal computer with serial communications capability is needed to access the bulletin board. The terminal should be set up for these communications parameters: 2400, 1200, or 300 modem baud rate; 8 data bits with no parity (or 7 with even parity); and 1 stop bit. Phone 301/948-5717 to connect with the board. The system is available 24 hours a day. For further information, call NCSL Security BBS assistance at 301/975-3359 or use the message subsystem of the bulletin board.

PHIGS CONFORMANCE TEST AVAILABLE

The Programmer's Hierarchical Interactive Graphics System (PHIGS) provides a standard library of routines for use in programming three-dimensional graphics. PHIGS is a Federal Information Processing Standard (FIPS 153), which adopts a voluntary industry standard (ANSI X3.144-1988). NIST has developed a test system to help users and vendors determine whether the complex data structures used to generate the graphics displays conform to FIPS 153. A future version will include interactive tests to determine if the visual output, the picture on the screen, is correct. The test suite consists of a set of FORTRAN programs that can be easily adapted for most computer system operating environments. The PHIGS validation test costs $1,000 for the first operating environment, $1,500 for two different environments, and $2,000 for three. Four or more will cost $2,500. A user guide describing the test suite installation and operation as well as guidance on interpreting the tests results is included. To order, contact John Cugini, A266 Technology Building, NIST, Gaithersburg, MD 20899, 301/975-3248.

BASICS OF CHEMICAL INSTRUMENTATION EXPLAINED

A recent NIST publication provides an introduction to chemical instrumentation for persons working outside the field of experimental chemistry. The Basics of Chemical Instrumentation, Volume 1—Separation Methods (NISTIR 89-3933) discusses the instrumentation and techniques of all major separation methods used in chemical analysis. The discussion begins with the characteristics of mixtures and the molecular properties affecting the separation process. Topics include gas chromatography, high-performance liquid chromatography, supercritical fluid chromatography, and electrophoresis. Important calibration methods are also discussed. NISTIR 89-3933 is available from the National Technical Information Service, Springfield, VA 22161. Order by PB #90-198458 for $23 prepaid. A volume on spectroscopic methods will be available later.

COAXIAL INTRINSIC IMPEDANCE STANDARDS DESCRIBED

Today's automatic network analyzers (ANAs) have resolutions better than the accuracy of the coaxial impedance standards used to calibrate them. ANAs are used to measure critical performance parameters of many types of microwave systems and to calibrate secondary standards used to support laboratory instrumentation. NIST has published a technical report that describes how microwave impedance standards are derived from basic dimensional metrology, how they are constructed, and how they are used in calibrating coaxial air-line systems using ANAs. It provides the first selected examples of how impedance measurement uncertainties depend on the effects of dimensional (or mechanical) tolerances for 14-, 7-, and 3.5-mm coaxial devices. Coaxial Intrinsic Impedance Standards (TN 1333) is available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402. Order by stock no. 003-003-02987-4 for $1.75 prepaid.

NIST, APL STUDY AUTOMATED ELECTRONICS ASSEMBLY

NIST and the Applied Physics Laboratory (APL) of the Johns Hopkins University have established a 1-year cooperative research program. The goal is to achieve productivity and quality improvements in computer-integrated manufacturing systems used for electronics assembly. Surface-mount printed-circuit boards would be a typical product. The project will include the specification of process and quality control techniques and strategies, computer hardware and software, data requirements, and interface and support standards, such as STEP (STandard for the Exchange of Product model data) and the Defense Department's CALS (Computer-aided Acquisition and Logistic Support) standards. New concepts for process control sensors will be tested. The project draws on NIST skill in process control sensors, automation, and standards technology, and APL expertise in applications and electronics manufacture.

NEW ACCREDITATION PROGRAM ANNOUNCED FOR TESTING LABS

NIST has established a laboratory accreditation program for labs that test plumbing products and devices. Labs can seek accreditation to test plumbing fixtures under ANSI Z124 standard series for plumbing plastics and to test fixture fittings and fixtures under ASME/ANSI 112 standards 18.1 and 19.2. The new program is part of the National Voluntary Laboratory Accreditation Program (NVLAP) for commercial products, which was established at the request of the International Coalition for Procurement Standards to provide buyers with a list of accredited labs that can test products to conform to contract specifications. The program also meets the needs of public authorities for energy and water conservation programs nationwide. Labs seeking accreditation for one or more of the test methods must meet all NVLAP criteria and renew their status annually to maintain accreditation. For information, contact Dr. Lawrence S. Galowin, NVLAP, A124 Building 411, NIST, Gaithersburg, MD 20899, 301/975-4022, fax: 301/975-3839.

GUIDELINES ISSUED FOR PRESSURE VESSEL SAFETY ASSESSMENT

Deterioration of certain kinds of pressure and storage vessels in the United States could result in the loss of dozens of lives and millions of dollars. A NIST study, sponsored by the Occupational Safety and Health Administration, gives an overview of stationary, unfired carbon steel and low-alloy steel pressure vessels for liquids and gases, and low-pressure storage tanks used at temperatures between −75 and 315 °C (−100 to 600 °F). These vessels are used in the process, pulp and paper, petroleum refining, and petroleum chemical industries, and for water treatment systems for boilers and steam generators. Guidelines for Pressure Vessel Safety Assessment (NIST SP 780) describes pertinent sections of ASME and API codes and standards governing vessel construction, testing, and inspection; causes of failure; and nondestructive inspection standards, practices, and methods. Data and information needed to assess the safety of these vessels and tanks are also given. SP 780 is available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402. Order by stock no. 003-003-03003-1 for $4.25 prepaid.

INDUSTRIAL FIRM TO CONSULT WITH NIST ON POLYMERS

A private company has established a research associate program at NIST to consult with institute scientists on non-proprietary polymer blends of polycarbonate and poly (methyl methacrylate) (PMMA) materials. Scientists from the industrial firm will use the NIST time-resolved light-scattering instrument and small-angle neutron scattering techniques at NIST's research reactor to measure the kinetics and thermodynamics of polymer blend phase behavior. Blends of PMMA with polycarbonates or other polymers are used widely in manufacturing transparent window panels or molded into large-scale plumbing fixtures such as bath tub enclosures and shower stalls. The NIST Research Associate Program provides an opportunity for engineers and scientists from industry, universities, technical societies, and other organizations to conduct cooperative research at NIST on projects of mutual interest, with salaries paid by the sponsor.

RISK ASSESSMENT THE DOE WAY

An important part of developing a computer security program is weighing the costs of controls against the risk of loss. Controls that are more expensive than the information they protect are not cost-effective. To help achieve a balance, NIST is investigating ways to identify risks and select appropriate cost-effective computer security

measures, that include making available information on methods developed by other federal agencies. NIST recently reprinted a publication describing the risk assessment method used by the U.S. Department of Energy (DOE). The DOE approach specifies six steps, including defining the system, software, and data; identifying threats; selecting countermeasures; and obtaining management review, participation, and accountability. Included in the publication are worksheets and tables needed to carry out each step. Also included is a sample completed worksheet, a bibliography, and a glossary. U.S. Department of Energy Risk Assessment Methodology (NISTIR 4325) is available from the National Technical Information Service, Springfield, VA 22161. Order by PB #90-244484 for $23 prepaid.

MEASURING FLOW IN THE SPACE SHUTTLE

NIST scientists are solving one of the world's trickiest measurement problems—gaging the superfast flow (up to 185 ft/s) of liquid oxygen in ducts of the space shuttle main engine. Accurate measurement is important to obtain maximum fuel efficiency in the huge engine. The flow velocity is almost 10 times greater than the maximum for which commercial flowmeters are designed. To make matters worse, the ducts are continuously curved, leaving very little space to install the meters. In smaller ducts, the meter has to be inserted through an instrument port less than half an inch in diameter. A NIST researcher has designed vortex shedding flowmeters, which have been tested with both water and liquid nitrogen. Some meters have measured flows up to 180 ft/s and can fit into the instrument ports. More testing is needed, and more work is required with sensors designed to convert the flow rate into electrical signals for readouts. Two papers discussing the project are available from Jo Emery, Division 104, NIST, Boulder, CO 80303, 303/497-3237. Ask for no. 31-90.

NINE GRANTS AWARDED FOR STATE TECHNOLOGY PROGRAMS

The Commerce Department's Technology Administration (TA) has announced the award of nine grants to state governments under the Boehlert-Rockefeller Technology Extension Program. The states receiving a total of $910,845 in grants include Arkansas, Georgia, Maryland, Massachusetts, Michigan, Minnesota, New York, Pennsylvania, and Tennessee. "One of the most exciting developments of the last few years in the area of technology transfer has been the appearance of an impressive array of imaginative, aggressive programs sponsored by state and local governments," said Under Secretary Robert M. White, who heads TA. The Boehlert-Rockefeller grant program was established under the 1988 Technology Competitiveness Act and is administered by NIST, which is part of TA. This is the first year that funding has been available for such grants. The grants are made for projects that either demonstrate cooperative programs with federal laboratories that can increase the use of government-developed technology by industry, or help businesses take advantage of services and information available from NIST or its Regional Centers for the Transfer of Manufacturing Technology.

IS YOUR OFFICE USER-FRIENDLY?

What do you consider the most important feature in an office? Functionality? Privacy? Aesthetics? How important are design and furnishings? As part of its ongoing program to assist the building industry, NIST researchers recently asked these questions of office space designers and facility managers from 22 major corporations and government agencies. The survey was conducted to provide insights about how offices and workstations are planned and designed. Included were the effects of technology on design, space allocations, and systems furnishings. Among the findings: respondents rated functionality, privacy, storage, and aesthetics as the top features needed for a high-quality workplace. In comparing today's offices with those of 5 years ago, they said that design and furnishings are more important now and that more space for support activities is needed. In addition, the group felt user input to workspace and equipment planning was very important. A report, High Technology Office Evaluation Survey—A Pilot Report (NISTIR 4354), is available from the National Technical Information Service, Springfield, VA 22161. Order by PB #90-244427/AS for $17 prepaid.

DIRECTORY PUBLISHED ON WEIGHTS AND MEASURES LABS

State Weights and Measures Laboratories: State Standards Program Description and Directory (NIST SP 791) is designed to help manufacturers and others in commerce and industry locate and obtain needed measurement services. The directory is a guide to state and other labs certified by NIST that are capable of performing reliable measurements with staff trained in proper procedures. To

be certified in a particular area, each state must have a trained metrologist and an adequate facility, and must demonstrate on a continuing basis that it is capable of providing valid measurements. NIST certification indicates the laboratory is capable of providing a measurement service, but each state is responsible for verifying its measurement traceability. The directory contains the following information for each lab: the certification period, if certified by NIST; lab staff members, addresses, and telephone or fax numbers; services available; and fees, if any, for services. Copies of SP 791 are available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402. Order by stock no. 003-003-03024-4 for $3.75 prepaid.

AUTOMATED STRESS ANALYSIS OF SOLDER JOINTS USING INSPECTION DATA

NIST is collaborating with the U.S. Army and private industry to develop a new procedure to assess the integrity of solder joints on certain advanced electronic packages, specifically, printed wiring boards manufactured using surface mount technology. Computer programs have been developed to convert coordinate points on the solder joint surface, obtained by advanced x-ray and optical inspection devices, into finite element meshes for stress analysis. Industry collaborators have provided trial data sets of over 1,000 *xyz* coordinate points on a solder joint surface from an x-ray laminography system and a laser vision system. Automated stress analysis will permit rapid assessment of the significance of geometrical irregularities on the reliability of the solder joints. The new method will be applied in the manufacture of products for the U.S. Army under the guidance of the Harry Diamond Laboratories.

REFRACTORY MATERIALS AT ULTRA-HIGH TEMPERATURES

Using a novel technique, under development at NIST, materials thermal stability data have been obtained for the first time at temperatures in the range of 3000-5000 K. The technique relies on use of a pulsed laser to produce the ultra-high temperatures, coupled with a high-pressure molecular beam sampling mass spectrometer system for vapor species determinations. Thermochemical data have been obtained for the refractory systems SiC and HfO2, which are under consideration for atmospheric re-entry aerospace applications at very high temperatures. The results of this work will be presented at a special Electrochemical Society Symposium on High Temperature Materials Chemistry.

NEW CERAMIC PHASES CHARACTERIZED IN COLLABORATIVE PROGRAM

Scientists from industry, academia, and NIST have begun a new collaborative program in the area of high-T_c superconductors. In this collaboration, new phases of compounds in the phase diagrams of strontium oxide, calcium oxide, bismuth oxide, and copper oxide have been synthesized, and their crystal structures are being determined to very high precision by means of neutron and x-ray diffraction. Neutron diffraction plays a critical role in this effort because of its sensitivity to light-atom positions even in the presence of heavy atoms, and the structural details that can be determined via Rietveld refinement even from polycrystalline samples.

The knowledge obtained from the elucidation of the structures of these new phases is directly related to the crystal chemistry, phase equilibria, and stability of the most important of the high-T_c superconductors discovered to date. This work will provide a part of the foundation needed for further advances in superconductor properties, critical to their technological applications.

NEW STANDARD FOR POLYMER PROCESSING

A new standard to be used in the process control of polymers has been prepared by NIST scientists. Six companies supported the development of the standard, which was produced under the auspices of ASTM subcommittee D20 on fundamental thermal properties. The new poly-propylene standard extends the temperature range of existing NIST standards used to calibrate the melt flow rate apparatus. This standard addresses the need for higher temperature calibrations brought about by recent trends to produce plastics products with higher use temperatures.

ASTM method D1238-88, Standard Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer, is commonly used by both polymer resin producers and users to determine the melt flow rate of polymer resins. The melt flow rate determines the pressure needed to inject or extrude a polymeric material at a desired rate of flow.

CONSORTIUM ON AUTOMATED ANALYTICAL LABORATORY SYSTEMS (CAALS) MEETS AT NIST

A 13-member consortium, comprised of instrument manufacturers, instrumentation users, and government agencies, have joined together to promote the development of automated analytical chemistry instrumentation. The initial CAALS undertaking is to develop guidelines for creating modular instruments that can be used to build analytical systems. Two such systems are currently being created to demonstrate CAALS concepts. Future plans call for building more intelligence into these analytical systems and improving the quality assurance of the information produced, so that eventually standard analytical methods can be built around this instrumentation. CAALS will provide its instrument manufacturing members with a strong, unified basis for competing in the worldwide marketplace and will provide its members who are users of instruments with new tools to handle their ever increasing demands for chemical information.

FIRST INFRARED SPECTRA OF DIMER IONS

Experiments at NIST have yielded infrared spectra for several molecular ions and dimer ions. Although laser-based gas-phase studies have yielded infrared spectral data for some simple molecular ions, no infrared data have ever before been obtained for dimer ions. In the NIST experiments, ions and dimer ions are frozen in a large excess of solid neon. This prevents the ions from reacting with molecules in the sample. Dimer ions that have been observed include O_{4+} and O_{4-}, key reaction intermediates in the chemistry of the Earth's stratosphere. Analysis of their infrared spectra has yielded important information on their structures and chemical bonding properties. Dimer ions are important chemical reaction intermediates in high-energy systems such as discharges used for the generation of laser radiation, industrial chemical synthesis, and plasma processing of semiconductors. Infrared spectra, in addition to being of fundamental scientific interest, can provide a basis for remote sensing techniques that monitor important reaction intermediates in chemical processes.

USER INTERFACE COMPONENT OF THE APPLICATIONS PORTABILITY PROFILE AS A FEDERAL INFORMATION PROCESSING STANDARD (FIPS) APPROVED

FIPS 158, User Interface Component of the Applications Portability Profile (APP), was recently approved for federal agency use. To be effective November 15, 1990, FIPS 158 adopts the X Protocol, Xlib Interface, Xt Intrinsics, and Bitmap Distribution Format specifications of the X Window System, Version 11, Release 3 (X Window System is a trademark of MIT). The new standard should be considered for network-based bit-mapped graphic systems that are developed or acquired for government use where distributed/networked bit-mapped graphic interfaces to multi-user computer systems are required. FIPS 158 addresses the user interface functional area of the APP that is described in FIPS 151-1, POSIX: portable operating system interface for computer environments.

NEW PUBLICATION DESCRIBES OBJECT DATABASE MANAGEMENT SYSTEMS

NIST Special Publication 500-179, Object Database Management Systems: Features and Concepts, provides managers and software analysts a state-of-the-art review of object database management systems (ODBMS). The emergence of object concepts and their infusion into information systems technology spanned the 1980s, beginning with the advent of programming languages that included object concepts. More recently, object concepts have been merged with database management system technology, resulting in the production of some object database management systems. As a result, the term ODBMS is now becoming a recognized and important topic in the database community.

MAGNETORESISTIVE RECORDING HEAD FABRICATED, MEASURED

A NIST scientist has fabricated a magnetoresistive head device and measured its magnetoresistive properties in a new program for developing methods to characterize advanced thin-film recording heads used with high-coercivity magnetic media. The magnetoresistive data show the presence of abrupt jumps in the plot of resistance as a function of magnetic field. These discontinuities result from Barkhausen noise, which is produced by the interaction of magnetic domain walls with microdefects and strains in the heads and severely degrades head performance. Methods of reducing this noise using new multilayered thin films will be a major focus of the research.

NIST DEVELOPS NEW OPTICALLY PUMPED INTEGRATED-OPTIC LASER

NIST scientists have designed, constructed, and operated a new miniaturized continuous-wave laser having a wavelength of 1057 nm. The scientists used integrated-circuit fabrication techniques in

conjunction with electric-field-assisted ion exchange to form the optical waveguide that serves as the laser cavity within a thin surface layer of a small plate of neodymium-doped soda-lime-silicate glass. The resulting channel waveguide is approximately 1 cm in length, 8 μm in width, and 6 μm in depth; these dimensions make it possible to use the laser with optical fiber systems. A commercially available laser diode provides optical pumping. NIST is continuing to study the present laser, for example to investigate an anticipated tuning range of 10 nm centered at the present 1057-nm line and lasing action at 900 and 1300 nm, suggested by the existence of strong photoluminescence peaks. In addition, NIST will use the fabrication technology it has developed to construct integrated-optic lasers with other rare earth dopants and glass hosts. One goal is to discover a combination that operates near the commercially important wavelength of 1500 nm. This work is part of the NIST program to develop metrology for lightwave technology; the group anticipates commercial interest in these results.

NIST, INDUSTRY APPLY EXPERT SYSTEM TO SCREEN PRODUCTION-LINE INTEGRATED CIRCUIT WAFERS

NIST and industry developed and tested an expert system for work-in-process (WIP) wafer screening. WIP screening involves making electrical measurements on a partially fabricated integrated-circuit wafer to predict what percentage of the finished circuits on the wafer will function correctly. Wafers for which a low percentage or yield is expected are discarded or reprocessed. NIST scientists first developed an expert system to analyze WIP data and then applied it to data from 90 wafers. Two hundred and fifty parameters were measured for each of about 20 test chips on each wafer. All of these wafers had been fabricated to completion, and the yield of each wafer was entered into the expert system along with WIP data. The expert system then identified which of the 250 parameters were significant in determining the yield. It constructed a decision tree so that chips could be classified by expected yield according to the values of these significant parameters. Based on the data from the 90 wafers, the expert system was able to classify accurately chips according to their expected yield in about 80 percent of the cases. Continued development of this measurement tool is expected to cut manufacturing costs significantly by avoiding needless processing for wafers that are destined to fail.

EGO-MOTION FIELD THEORY DEVELOPED

A new theory of ego-motion and optical flow has been developed by NIST. Ego-motion is the motion of a camera through a 3-D environment. Optical flow is the flow of intensity information across the camera image plane as the camera moves. The theory describes the structure of a field in 3-D space consisting of contours and surfaces surrounding the moving camera. If static objects are placed anywhere in the surrounding space, the optical flow produced by these objects in the camera is predicted by the field theory. The field is always centered at the camera focal point and moves with the camera. The structure of the field changes as a function of the instantaneous camera motion.

NIST has tested the theory with many experiments using simulations and lab set-ups. It has been applied most heavily to obtaining a quantitative understanding of camera fixation, i.e., controlling the camera orientation during motion so that it continuously points at a single point in space. NIST is currently applying the theory to the problem of road following, where the goal is to control autonomously a vehicle so that it follows a road only using information obtained from a camera mounted on the vehicle.

Calibration Services

INEXPENSIVE FREQUENCY CALIBRATION SERVICE AVAILABLE

The NIST Automated Computer Time Service (ACTS), a dial-up service begun in 1988, can also act as an inexpensive frequency calibration service. NIST researchers have found that a frequency calibration accuracy of better than one part in a billion is readily available from a single long telephone call or from a sequence of short calls averaged over a few days. The cost of hardware and software for ACTS is only about $100 versus up to several thousand dollars for most other frequency dissemination services with this level of accuracy. Access ACTS by dialing 303/497-4774. Software

can be obtained for $36 from the Standard Reference Materials Program, Rm. 204 Building 202, NIST, Gaithersburg, MD 20899, 301/975-6776. Ask for Automated Computer Time Service, RM 8101. The system will work with modems with rates of 300 bits/s or 1200 bits/s. Modems at 300 bits/s seem to offer better stability. Paper no. 44-90 describes the service and is available from Jo Emery, Div. 104, NIST, Boulder, CO 80303, 303/497-3237.

NIST ESTABLISHES SPECIAL-TEST SERVICES FOR COMPLEX PERMITTIVITY MEASUREMENT

NIST has announced the establishment of new special-test services for dielectric material measurement. These services result from a 3-year effort to establish national traceability for measurements of electromagnetic parameters of materials. NIST has concentrated its initial work on the development of methods for measuring the permittivity, or dielectric constant, of low-loss materials. Accomplishments underlying the new service include the development of a precision resonant cavity, together with rigorous characterization of the cavity system and of its uncertainty; development of a broadband method based on a coaxial transmission line; and participation in national and international comparisons. The new services are available solely on a prearrangement basis and at present are limited to solid, low-loss dielectric materials that are linear, homogeneous, isotropic, and nonmagnetic. All measurements currently are performed at room temperature (23 °C). Two classes of dielectric measurement services are available. The most precise is a measurement in the resonant cavity near 10 GHz with an accuracy of 0.5 percent for the dielectric constant. Less accurate broadband measurements are available in 7-mm coaxial transmission line from 50 MHz to 18 GHz, in WR284 waveguide from 2.6 to 3.95 GHz, and in WR90 waveguide from 8.2 to 12.4 GHz.

Standard Reference Materials

MATERIALS CAN HELP EVALUATE INDUSTRIAL ATMOSPHERE

Regulatory agencies and others studying the toxic metal concentration of industrial environments now have a new tool to help them achieve the most accurate measurements possible. It is a series of cellulose filters, similar to the ones used to sample atmospheric specimens, each containing certified concentrations of nine metals known to be toxic at certain levels. The filters that make up this standard reference material (SRM) can be dissolved easily in acid and diluted with distilled water to the desired volume and concentration level. In solution form, the SRM can be used in atomic absorption, optical emission (plasma), spectrometry, spectrophotometry, or any other analytical techniques that require aqueous (water-based) standard solutions for calibrating instruments. Metals represented on each of the filters are barium carbonate, cadmium, chromium, iron, magnesium, nickel, lead, selenium, and zinc. Each SRM consists of six filters containing the metals and five blank filters that allow chemists to assess the ambient levels of the metals being measured. SRM 3087, Metals on Filter Media, sells for $155 and is available from the Standard Reference Materials Program, Rm. 215 Building 202, NIST, Gaithersburg, MD 20899, 301/975-6776.

X-RAY FLUORESCENCE SPECTROMETRY ORE AVAILABLE

A new fused ore x-ray fluorescence spectrometry standard has been developed by NIST for laboratories that analyze the constituent elements in rocks, ores, and clay. Standard reference material (SRM) 1834 is a silica base glass disk, 3 cm in diameter by 0.3-cm thick, for calibrating instruments. The synthetic glass material has an elemental composition similar to SRM 97a, Flint Clay, with the amount lost on ignition replaced by oxides of lithium and boron. SRM 1834 also can be used in quality-control applications and to monitor instrument stability. The new SRM has certified weight percent values for the following constituent elements: aluminum, barium, calcium, iron, magnesium, phosphorus, potassium, silicon, strontium, and titanium. SRM 1834, Fused Simulated Ore for X-Ray Fluorescence Spectrometry, is available for $298 from the Standard Reference Materials Program, Rm. 215 Building 202, NIST, Gaithersburg, MD 20899, 301/975-6776.

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Standard Reference Data

DATABASE TO HELP TEST WRITING RECOGNITION DEVICES

A first-of-its-kind database containing over 1,000,000 handprinted characters has been developed by NIST to help measure the performance of systems designed to read unconstrained handwritten letters and numbers. Banks, insurance companies, and other form-processing organizations represent an enormous market for these systems. But such machines are not available, largely because of wide variations in writing style. Finding a standardized way to measure machine performance is an important link in developing the technology. To collect handwriting samples, NIST researchers asked more than 2,000 employees from the U.S. Bureau of the Census to fill out sample forms. NIST Special Database 1—Binary Images of Printed Digits, Alphas and Text is available on an ISO 9660 format CD-ROM disk for $895 from the Standard Reference Data Program, A323 Physics Building, NIST, Gaithersburg, MD 20899, 301/975-2208.

STANDARD REFERENCE DATA PRODUCTS CATALOG PUBLISHED

NIST Standard Reference Data Products 1990 Catalog (NIST Special Publication 782) provides the latest information on various data compilations, publications, and computerized databases that may be obtained from NIST and other sources. Critically evaluated data compilations for science and industry are available in the following areas: analytical chemistry, atomic physics, chemical kinetics, materials properties, molecular structure and spectroscopy, thermochemistry, and the thermophysical properties of fluids. Since 1968, the NIST Standard Reference Data Program has been responsible for coordinating on a national basis the evaluation of numerical data in the physical sciences. The evaluation of chemical and physical properties of substances and materials is carried out in the National Standard Reference Data System network of data centers. To obtain a copy of SP 782, send a self-addressed mailing label to Standard Reference Data Program, A323 Physics Building, NIST, Gaithersburg, MD 20899, 301/975-2208.

PC DATABASE AVAILABLE FOR HYDROCARBON MIXTURES

NIST scientists have developed a new database for calculating density, viscosity, and other important engineering property data of hydrocarbon mixtures petroleum, natural gas, and organic materials. The NIST Thermophysical Properties of Hydrocarbon Mixtures (Supertrapp) database is designed to provide rapid access to vital information on the storage and transportation of fluids, and for the design of new chemical processes. It is available on a floppy disk for personal computers (PCs). The interactive program allows users to calculate quickly various thermodynamic and transport properties for pure fluids or for mixtures of up to 20 components. These mixtures can be selected from a database of 116 components, mostly hydrocarbons such as ethane, hexane, and methane, and hydrocarbons as heavy as tetracosane. Some non-hydrocarbons, such as carbon dioxide, nitrogen, and oxygen, are included. NIST Standard Reference Database 4, Supertrapp, is available for $490 from the Standard Reference Data Program, A323 Physics Building, NIST, Gaithersburg, MD 20899, 301/975-2208.

MAJOR EXPANSION MADE TO CHEMICAL KINETICS DATABASE

The NIST Chemical Kinetics Database for personal computers (PCs) now contains information on the rates of more than 5,000 chemical reactions with more than 12,000 individual entries that include data on 2,400 compounds that are reactants or products. Chemists, environmentalists, and engineers will find it useful for modeling combustion systems, gas phase reactors, and chemical processes occurring in the atmosphere. These data are necessary to understand the reactions of such chemicals as fluorocarbons and their role in depleting the Earth's ozone layer. The database has increased searching speed and contains several new features, such as the simultaneous display of abstracts and graphics. Users can search by author name, add data to be plotted, and store comments and other information. PC Version 2.0 of the Chemical Kinetics Database, Standard Reference Database 17, is available for $300. It can be stored on the hard disk of any AT or XT-Class PC where it occupies 3.5 megabytes. Users of PC Version 1.0 may upgrade for $100. To order PC Version 2.0, contact the Standard Reference Data Program, A323 Physics Building, NIST, Gaithersburg, MD 20899, 301/975-2208.

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DIPPR DATABASE EXPANDED TO 1,117 COMPOUNDS

The DIPPR (Design Institute for Physical Property Data) Data Compilation of Pure Compound Properties, 1990, now contains information on 39 properties for 1,117 pure chemical compounds of high industrial priority. The DIPPR database provides chemical engineers, manufacturers, and scientists with quick access to important information on the behavior of substances and their properties at various temperatures. The database includes information on the thermodynamic, physical, and transport properties of each chemical. Values are given for 26 single-valued property constants for each compound and for 13 properties as functions of temperature, calculated from correlation coefficients. The chemicals were selected by industry members of the American Institute of Chemical Engineers' (AIChE) DIPPR group and are considered to be the most important ones to industry. DIPPR, NIST Standard Reference Database 11, is available for $3,400 on standard diskettes for personal computers (PCs) or on magnetic tape. To order PC Version 5.0 or to obtain a license agreement for the database in magnetic-tape form, contact the Standard Reference Data Program, A320 Physics Building, NIST, Gaithersburg, MD 20899, 301/975-2208.