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News Briefs

General Developments

Inquiries about News Briefs, where no contact person is identified, should be referred to the Managing Editor, Journal of Research, National Institute of Standards and Technology, Building 416, Room 119, Gaithersburg, MD 20899-0001; telephone: 301/975-3572.

NEW WEB SITE SERVES AS GUIDE TO NII

The Clinton Administration's Information Infrastructure Task Force recently launched an online resource to help people better understand benefits of the National Information Infrastructure, sometimes referred to as the ''information superhighway.'' The NII Virtual Library home page provides any user with explanations of the NII and how it works and provides system developers with information on NII applications. The new World Wide Web site, co-sponsored by the IITF and the Council on Competitiveness, features links to information sites developed by universities, museums, large corporations, small businesses, government agencies, non-profit groups and other organizations with an interest in using the NII. It was developed by the IITF Committee on Applications and Technology with the support of the Office of Enterprise Integration at NIST. The site can be reached at http://nii.nist.gov by anyone with a properly equipped computer running World Wide Web browsing software, such as Mosaic or Netscape. For technical assistance when accessing the home page, contact Rick Kuhn at (301) 975-4601 or e-mail: rkuhn@nist.gov (via Internet).

PHOTOVOLTAIC HOT WATER SYSTEM EXCEEDS EXPECTATIONS

A full-scale prototype of a novel solar water heating system—the first to use photovoltaic cells in combination with computer technology to capture the sun's energy—has performed better than expected during testing at NIST's headquarters in Gaithersburg, MD. PV cells are semiconductor devices that convert the energy in sunlight into electricity. These cells allow the NIST system to directly heat water in its tank, a distinct advantage over traditional devices that pump water to a rooftop solar collector and then return the heated liquid to storage. The NIST tests used a computer-based data acquisition method to withdraw hot water from the system as if used by a typical family of four. During a recent 3 month monitoring period, the NIST solar water heater provided 67 % of the total energy required versus a projected 50 % contribution. As a result, NIST engineers currently are reducing the size of the PV array by 25 % and making other modifications to yield a less expensive system. Monitoring of the revised water heater began in June. Industry partners on this project are welcomed. Contact Hunter Fanney, B320 Building Research Building, NIST, Gaithersburg, MD 20899-0001, (301) 975-5864, e-mail: hunter@micf.nist.gov (via Internet).

STRESS MEASUREMENTS ASSESS RAILROAD WHEEL SAFETY

Railroad wheel failure is commonly caused by cracks that propagate from the rim toward the hub. Wheels are manufactured to put the rim under residual compressive stress, which tends to close these cracks and prevent wheel failure. However, heavy braking can heat the wheel enough to make the rim stress become tensile, promoting the propagation of cracks. Detecting this reversed stress condition traditionally has been done by visual inspection of discolorations. NIST has collaborated with the Association of American Railways and two Polish research groups to develop ultrasonic methods for detecting stress in wheels. The results of this work are promising and are reported in two papers (numbers 13-95a and 13-95b) available from Sarabeth Harris, Div. 104, NIST, Boulder, CO 80303-3328, (303) 497-3237, e-mail: sarabeth@micf.nist.gov (via Internet). For technical information, contact Ray Schramm, Div. 853, NIST, Boulder, CO 80303-3328, (303) 497-3232, e-mail: schramm@boulder.nist.gov (via Internet).

AUGUST CONFERENCE FOCUSES ON DIAMOND APPLICATIONS

Rapid progress in processing technologies soon could lead to new diamond materials applications in sensors, flat-panel displays, wear-resistant surfaces, cutting tools, electronics and opto-electronic devices. Diamond, the hardest known natural material, also has the highest thermal conductivity. Its physical and chemical properties make it ideal for use in aerospace products, electronics and industrial equipment. To identify technical barriers hindering the development of large-scale commercial applications of diamond and diamond films, the Third International Conference on the Applications of Diamond Films and Related Materials was held Aug. 21-24, 1995, at NIST headquarters in Gaithersburg, MD. Manufacturers and users of diamond and related materials discussed recent technological advances with materials researchers. For technical information, contact Albert Feldman, A329 Materials Building, NIST, Gaithersburg, MD 20899-0001, (301) 975-5740, fax: (301) 990-8729, e-mail: feldman@micf.nist.gov (via Internet).

ACCURATE PRICES GOAL OF NEW NCWM PROCEDURE

State and local government officials attending the 80th Annual Meeting of the National Conference on Weights and Measures in Portland, Maine, July 16-20, 1995, voted on the adoption of a procedure for verifying the accuracy of retail store prices. The procedure, which involves checking the prices of products scanned at a store's checkout counter against the advertised prices for the products, helps ensure that consumers are correctly charged for items they purchase. The proposed procedure represents a cooperative effort among more than 500 retailers, consumer representatives, and state and local weights and measures officials. The procedure must be adopted officially by individual states to become law. NCWM is an organization of state, county and city weights and measures enforcement officials and associated business, federal and consumer representatives. Through its Office of Weights and Measures, NIST provides technical assistance to NCWM. For more information on the conference and the 80th Annual Meeting, contact the NCWM at P.O. Box 4025, Gaithersburg, MD 20885, (301) 975-4004, fax: (301) 926-0647.

USDA ADOPTS UPDATED VERSIONS OF TWO NIST HANDBOOKS

On March 9, 1995 the Food Safety and Inspection Service of the U.S. Department of Agriculture published a final rule amending the federal meat and poultry products inspection regulations to adopt updated editions of two NIST handbooks. The rule, which went into effect May 8, adopts applicable portions of NIST Handbook 44, Specifications, Tolerances, and Other Technical Requirements for Measuring Devices, 1994 Edition, and NIST Handbook 133, Checking the Net Contents of Packaged Goods, Third Edition and supplements 1-4. The handbooks are published by the Weights and Measures Program in the Office of Standards Services in cooperation with the National Conference on Weights and Measures.

ENERGY-RELATED INVENTIONS PROGRAM RECOMMENDATIONS

The NIST Office of Technology Evaluation and Assessment recommended these innovative technologies for commercialization to its DOE partner under the Energy-Related Inventions Program during February and March:

- Clemson Camshaft—an innovative design for a camshaft for internal combustion engines that will allow variable intake or exhaust valve timing. Two concentric shafts carry separate components of the cams so that relative rotation of the two shafts can change the action of the cams. A novel feature is the use of a single shaft to perform the timing events and their duration, which is important to domestic manufacturers who want to extend the design life of their pushrod engines.
- Apparatus for Removing Bark from Whole Logs—an apparatus designed to remove bark from delimbed tree stems by raising stems from the bottom of a mass of stems and dropping them back on top of the pile. Abrasion from moving the logs into position to drop onto the pile, and compressive forces from the impact of the stems, loosen and remove the bark. Innovative features include the degree of contro afforded the operator in terms of early removal of logs that have been debarked to specification or the recycling of logs that are not, and the tailoring of the debarking process to a particular species of tree.

NIST HELPS COMPANY WITH MEASUREMENT OF PULSE ENERGY FOR INKJET PRINT-HEADS

A NIST scientist has helped a private company in an assessment of methods for measuring the pulse energy delivered to print-heads marketed by the company for use in inkjet printers. The worldwide print-head market now tops $1 billion annually, with a high growth rate. Print quality is critically dependent on the amount of total energy delivered by well-defined electrical pulses to the load resistor in each of an array of little reservoirs; these pulses are typically a few microseconds in duration and several volts in amplitude (the resistor heats the ink to the boiling point, and as a result droplets are ejected through a small orifice onto the paper). The scientist initially applied the NIST-developed sampling comparator system to determine if the method presently used by the company could achieve the desired uncertainty in energy measurement of ± 1 %. Errors due to frequency response of the load resistor, short-term instability of the pulse generator, noise and residual gain/offset errors, errors in the sampling system time-base, and frequency response errors of the sampling probes were taken into account. The scientist then evaluated an approach for assuring traceability for these measurements using a root-mean-square voltmeter, but he found this method had insufficient accuracy and repeatability. Finally, he was able to demonstrate that a sufficiently small uncertainty could be achieved by using the waveforms from a calibrated commercial pulse generator to calibrate the sampling oscilloscope used in the companies test system. To maintain traceability to NIST standards, the scientists recommended that a reference pulse generator for each test system periodically be sent to NIST for calibration. The results of this evaluation were documented in a report prepared for the private company.

BIOELECTRICAL IMPEDANCE ANALYZERS STUDIED

A NIST scientist has completed a project to evaluate the performance of six commercial bioelectrical impedance analyzers (BIAs). BIAs are widely used to measure body composition by health-researchers, hospitals and clinics, as well as diet and fitness centers. NIH (National Institutes of Health) had some concerns about the measurement consistency of these instruments, in part because most of the clinical studies that relate body impedance to disease assume that the BIAs are error free. The NIST scientist found that the disagreement between analyzers ranged from 1 % to as high as 20 % for measurements of known artifacts that simulate body impedance components. He described his results last December at NIH at the Technology Assessment Conference on Bioelectrical Impedance Analysis in Body Composition Measurement in the paper ''Overview of Bioelectrical Impedance Analyzers.'' The paper now has been submitted for publication in the American Journal of Clinical Nutrition.

There have been several thousand technical papers published on the application of BIAs, with several hundred new papers each year.

A typical BIA measures complex body impedance between the wrist and ankle at 50 kHz. Algorithms in the BIA software use this information, along with body height, to determine total body water, assuming that the applied current is conducted primarily in extracellular body water. Body fat is predicted using algorithms that incorporate additional body parameters such as body weight.

PARTIAL DISCHARGE MEASUREMENT LABORATORY ESTABLISHED

A new laboratory for developing methods for detecting and characterizing partial discharges (PDs) has been constructed by NIST. The laboratory is equipped with several high-voltage sources and can study PDs originating in a variety of insulation systems, including gases, liquids, and solids. Excitation voltages can be generated for sinusoidal test voltages up to 40 kV from 50 Hz to 1000 Hz, as well as dc voltages of either polarity, also up to 40 kV. When equipment on order arrives, laboratory capabilities will encompass arbitrary waveforms with amplitudes up to 120 kV and frequencies between dc and 15 kHz. All sources are under computer control and monitoring. PD data is collected using both the NIST analog stochastic analyzer and the new NIST PD digitizer. The latter allows continuous real-time measurement and recording on a computer diskette of the amplitude and phase of all PD pulses. The resulting data files are processed with custom stochastic analysis software to gain further insight into the PD phenomena. Comparison with the same analysis made independently with the analog system provides validation of the computer-based process. The new laboratory is already hosting several projects. The U.S. Nuclear Regulatory Commission is supporting an investigation into using PD to evaluate the quality of low-voltage cables that have been used in nuclear power plants, and the Air Force Wright Laboratory has contracted with NIST to design and fabricate a modified PD digitizer, as well as supply the needed control and analysis software, for the testing of PD at low air pressures. The lab also recently hosted a week of PD testing in collaboration with a visiting scientist from the Instytut Elektrotechniki in Warsaw, Poland.

NIST FACILITATES INTERNATIONAL WORKSHOP ON ULTRA-SHALLOW PROFILES IN SEMICONDUCTORS

The Third International Workshop on the Measurement and Characterization of Ultra-Shallow Doping Profiles in Semiconductors was held recently in Research Triangle Park, NC, drawing over 130 participants. The workshop was sponsored by several organizations including NIST. The topic of dopant profile measurement has long been important for process development and process monitoring. Rapid shrinking of device dimensions, now requiring vertical junction depths of 100 nm or less, has continually challenged the best of profiling techniques in one dimension. Now the needs for accurate two-dimensional profiles on the part of device designers, as articulated in the Semiconductor Industry Association National Technology Roadmap for Semiconductors, and consequently on the part of those who develop computer-aided device design software, have added significant complexity to the challenge. There is concern that insufficient progress in dopant profiling capability could be a ''show-stopper'' in meeting roadmap goals. The workshop featured four keynote talks and an additional 47 papers and posters by authors from ten different countries, in sessions on process model verification, electrical characterization, depth profiling using sputter techniques to remove material, and electron and scanning-probe microscopies. Peer-reviewed versions of the workshop manuscripts will be published in the January/February 1996 issue of the Journal of Vacuum Science and Technology B.

NIST TESTING MACHINING CENTERS FOR INDUSTRY

NIST scientists have begun evaluating the NIST Interim Testing Artifact (ITA) for use in error diagnostics of machining centers. Originally developed for rapid interim testing of coordinate measuring machines, the ITA may be used to characterize the performance of numerically controlled machine tools using touch probes in place of the normal tooling. NIST personnel have used the ITA in preliminary field testing at a private company's large-scale composite fabrication facility. The tests involved three large machines which are used for final shaping of carbon fiber composite components that are assembled to form the sound-suppression engine casings for the new Boeing 777 twinjet commercial airliner. Data collected from the machines at the company is electronically transmitted to NIST for processing and analysis. The types of machine errors that are detected include those caused by temperature gradients, squareness and angular motions of the machines' linear axes, and errors in the calibration procedures and mechanical adjustments of the touch probes used. These tests will provide valuable baseline data on factory-floor applications of the high-accuracy testing artifact and may lead to routine machine tool interim testing as a part of standard quality control procedures.

NIST AND PRIVATE COMPANY COLLABORATE IN PRESENTING THE PRACTICAL APPLICATION OF SCANNED PROBE MICROSCOPY

A NIST scientist presented a paper entitled ''Progress in Accurate Metrology of Pitch, Height, Roughness, and Width Measurements Using an Atomic Force Microscope'' at the Society of Photo-Optical Instrumentation Engineers (SPIE) Microlithography Conference. The NIST scientist and a private company scientist also taught a course on scanned probe microscopy to commercial metrologists. The course was designed for commercial metrologists who are interested in beginning and expanding their use of scanned probe microscopy in a semiconductor environment. The scientists presented the calibration of commercial instruments as they relate to accuracy and repeatability and various technical operational practical issues that industry personnel, who use this new technology for process development and control, face. The private company scientist provided information on the use of scanned probe microscopy in a manufacturing environment. NIST provided the laboratory standards and calibration perspective.

NIST'S PARTICIPATION IN THE NEWLY LAUNCHED APPAREL RESEARCH NETWORK PROGRAM

The Defense Logistics Agency (DLA) recently has launched a 7-year R&D program to support the apparel industry. The program is named the Apparel Research Network (ARN). The primary objective of ARN is to strengthen the U.S. apparel industry's ability to meet DOD requirements through a program of research, education, industrial extension, and factory implementation. The goal of the ARN program is to get the uniform on the customer at the right time, right place, right cost, and right fit. Through DLA's Broad Agency Announcement, the agency has selected 24 partners including educational institutions, apparel manufacturers, equipment suppliers, and software developers. A special arrangement has been made to extend the partnership to include NIST, the only non-DOD government agency involved in the program. Three workshops have been held since the November 1994 kick-off meeting. The purpose of these workshops is to coordinate the process of the

overall ARN technical strategy, in particular a roadmap of ARN, and management. NIST is actively involved with the development of the roadmap for ARN. It is expected that a complete roadmap will soon be defined. Research projects then will be proposed and started. NIST's primary interests in ARN include integration, product data definition and exchange, and special measurements.

X-RAY SPECTROMETRY IN ELECTRON BEAM INSTRUMENTS

X-Ray Spectrometry in Electron Beam Instruments, edited by two University scientists and a NISTscientist and published in May, 1995 by Plenum Press, N.Y., is the record of a topical symposium held by the Microbeam Analysis Society in honor of a deceased NIST scientist. The contributors include many of the world's leading experts in the field of analytical x-ray spectrometry for microanalysis. The topics covered span the entire range of the field and include design of silicon-based energy dispersive detectors, detector windows, germanium-based detectors, modeling detector response, special problems in low-energy x-ray spectrometry, digital pulse processing, multiple linear regression peak fitting, EDS detector artifacts, EDS detector operation in the analytical electron microscope environment, detector operation in ultra-high vacuum environments, wavelength dispersive x-ray spectrometry, synthetic multilayer diffraction crystals, fitting wavelength dispersive x-ray spectra with NIST/NIH Desktop Spectrum Analyzer, and an evaluation of quantitative analysis methods. This volume should provide an important reference for practical x-ray microanalysis and should serve to stimulate discussion and research to advance the state of the art in x-ray spectrometry.

NEW PUBLICATION FOCUSES ON ANALYTICAL METHODS FOR CANCER CHEMOPREVENTIVE AGENTS

NIST Special Publication 874, Methods for Analysis of Cancer Chemopreventive Agents in Human Serum, is a compilation of methods developed and critically evaluated at NIST for the measurement of selected vitamins, carotenoids, and other micronutrients in human serum. These compounds are under investigation world-wide for their efficacy in reducing the risk of developing certain types of cancers. This reference manual was established as a result of NIST efforts in providing consultative services and analytical-measurement quality assurance for 50 laboratories that participate in a Micronutrients Measurement Quality Assurance Program co-sponsored by the National Cancer Institute. This document serves as a means of transferring NIST measurement expertise to clinical laboratories involved in epidemiological studies and clinical trials to establish the cancer-preventive efficacy of these compounds.

WORKSHOP ON THE ''TREATMENT OF GASEOUS EMISSIONS VIA PLASMA TECHNOLOGY'' HOSTED BY NIST

A workshop on the use of non-thermal plasma technology for treatment of gaseous emissions was held March 20-21, 1995 in Gaithersburg, MD. The workshop, subtitled ''Present Status and Future Needs,'' was co-sponsored by NIST, Battelle Pacific Northwest Laboratory, and the Strategic Environmental Research and Development Program. Attendees were 120 scientists and engineers from U.S. and foreign industrial, government, and academic laboratories.

The purpose of the workshop was to examine the common issues facing industry with regard to the use of plasma chemistry and engineering for treatment of gaseous emissions, and to evaluate the role of plasma technologies in meeting the demand for control and treatment of gases with adverse environmental impacts. The workshop consisted of invited talks and breakout sessions with particular focus on the status and needs for chemical data, predictive modeling, and device development as well as the cost and commercialization of plasma technologies.

The workshop report now being generated will describe the potential applications, current status, and research and development needs which must be addressed in order to accelerate the development of plasma technology into commercial products useful for chemical processing and environmental cleanup and control.

NIST PARALLEL APPLICATIONS DEVELOPMENT ENVIRONMENT (PADE) RELEASED

A major trend in high-performance computing is message-passing parallelism, in which independent processors work on parts of a common problem and communicate with each other by exchanging messages over a network. Rapid growth of message-passing parallelism has been stimulated by the widespread use of a software package, PVM, with which an ordinary user can connect any number of networked Unix workstations to form a ''parallel virtual machine.''

However, programming such a machine is a complex task, especially when it is made of workstations with different file and operating systems. NIST scientists have written a software package to simplify this process. This

software, the NIST Parallel Applications Development Environment (PADE), provides a virtual console, in the form of a graphical interface program running on a single workstation, which utilizes a parallel ''make'' utility to support all phases of parallel application development: editing, compilation, execution, debugging, and performance monitoring.

NANODETECTOR PRODUCES FIRST IMAGES

The ''nanodetector,'' a unique EUV/x-ray microscope for high-resolution imaging, has produced its first images. This instrument converts an EUV or x-ray image into a photoelectron image which is then magnified by a low-energy electron microscope. In one mode of operation, a sample is placed on the transmission photocathode membrane (the element that converts the x-rays to electrons) where differential absorption by the various structures of the sample causes varying amounts of EUV to be transmitted to the underlying photocathode surface. A magnified image of the resultant photoelectron shadowgraph of the sample is then projected onto a phosphor screen which is viewed by a CCD camera to give essentially real time viewing of the sample. When fully operational, the microscope should be capable of resolving structures as small as 20 nm, the present state-of-the-art for x-ray microscopy. The nanodetector was designed for several measurement applications. One is soft x-ray biological microscopy, a rapidly growing field where the advantages over electron microscopy are less sample preparation and less damaging radiation. Another application is high-resolution compositional mapping of nanostructures, especially nonconductors where electron microscopy techniques are hampered by charging effects. A third planned application employs the use of x-ray magnetic dichroism as a contrast mechanism for the mapping of magnetic domains with both elemental and spatial resolution.

CRADA SIGNED WITH PRIVATE COMPANY TO SHARE PARALLEL COMPUTING SOFTWARE

NIST has signed a CRADA with a private company to share parallel computing software. The NIST researchers will develop a new set of computer codes to calculate atomic wave functions using parallel computers. The company will provide access to their parallel computers and new mathematical software specifically designed for parallel computing. Algorithms developed and results obtained by the NIST researchers will be incorporated into the molecular wave function codes the company is developing for applications to complex molecules and catalysts. The atomic structure codes to be developed by the NIST scientists will provide predictive capabilities far superior to any existing computer codes. They will be used to predict transition probabilities and collision cross sections of heavy elements used in mercury-free fluorescent lamps, fusion plasma diagnosis, x-ray lasers, magnetic materials, pollution detectors, and catalysts. The atomic theory group already has succeeded in reducing the computing time of one of their codes by a factor of 10 using 15 nodes on NIST's SP2 computer.

NIST AND THE COUNCIL ON IONIZING RADIATION MEASUREMENTS AND STANDARDS HOST WORKSHOP ON RADIATION PROTECTION

NIST and the Council on Ionizing Radiation Measurements and Standards (CIRMS) jointly sponsored a workshop held at NIST March 1-2, 1995. The purpose of this workshop was to review the status of the NIST National Voluntary Laboratory Accreditation Program (NVLAP) for personnel protection dosimetry, particularly in view of recent revisions of the American National Standard for Personnel Dosimetry Performance—Criteria for Testing (ANSI N13.11− 1993). A NIST scientist participated in the development of the current revisions to this standard and has advised NVLAP on their implementation.

More than 20 participants discussed the impact of the revised standard and the new direction being pursued both by the NVLAP and by the Department of Energy Laboratory Accreditation Program. The dosimetry for all U.S. radiation workers is traceable to NIST through one of these two programs. Representatives from the two programs' administration and performance testing laboratories attended, along with representatives from groups directly affected by the programs, such as the Nuclear Regulatory Commission, the nuclear power industry, and personnel dosimetry service companies. The workshop also included discussion of anticipated dosimetry performance issues, including extremity dosimetry testing and electronic dosimetry testing. The convening of those who set the standards, those who administer them, and those who use them resulted in a highly constructive workshop.

PHOTONIC FILMS

Single crystal electro-optic films have potential applications in miniaturizing future photonic telecommunication and image-processing systems. Because of its large electro-optic coefficient, barium titanate is an important electro-optic material. Devices fabricated from barium titanate, such as optical switches and modulators, could

be made much smaller than current commercial devices made from lithium niobate. However, success in producing single crystal barium titanate films has been limited to date. A milestone to success is the deposition of epitaxial barium titanate on other inexpensive single crystal substrates.

NIST scientists succeeded in depositing by thermal metal-organic chemical vapor deposition, state-of-the-art barium titanate thin films epitaxially onto single crystal magnesium oxide substrates at 600 °C, a temperature at least 200 °C lower than that reported by other investigators. The advantages of depositing at a lower temperature are better compatibility with standard silicon device processing technology, less interdiffusion with the substrate, and lower concentrations of thermally activated defects. All of these factors are critical to developing thin film electro-optic photonic devices.

WORKSHOP ON MATERIALS PROPERTY MEASUREMENTS

A workshop to identify technology gaps in detecting the degradation of materials used in electric power generation was conducted by NIST in cooperation with the Department of Energy and the Electric Power Research Institute (EPRI) at the EPRI NDE Center in Charlotte, NC, April 11-13, 1995. Since 80 % of the electric power used in the United States comes from fossil fuel plants that expose materials to high temperatures in corrosive environments for long periods of time, the detection of generalized degradation and the prediction of remaining life have potential to reduce maintenance and operating budgets. These same problems also appear in oil refineries, chemical processing plants, and paper mills. The workshop concluded that three areas of research need to be addressed: (1) the detection and characterization of void clusters and microcracks during the early stages of creep, stress corrosion, and fatigue; (2) the measurement and monitoring of stress distributions; and (3) the development of non-destructive tests for such mechanical properties as fracture toughness, hardness, and ultimate tensile strength.

X-RAY DIFFRACTION IMAGING OF ZnSe SUBSTRATES FOR BLUE-GREEN LEDs

The commercial application of ZnSe depends on the ability to grow high-quality crystals as substrates for the growth of device heterostructures. A private company, a grower of ZnSe crystals, has been collaborating with NIST to characterize single-crystal substrates to relate growth conditions and processing parameters to defect generation. The ultimate goal is to improve crystal perfection and, therefore, the yield of device material.

Using synchrotron-radiation diffraction imaging, NIST scientists have observed defects in ZnSe crystals such as subgrain boundaries, inclusions, inhomogeneous strain, and residual subsurface damage. Surface reflection images show a ''texture'' which is directly related to the bulk defect density. Subsurface damage results from the processing of wafers from the as-grown boule and chemo-mechanical polishing produces an ''orange peel'' texture in the microstructure. Images from the best crystal allowed NIST scientists to count individual dislocations. The measured defect density, between 640/cm^2 and 1300/cm^2, compares favorably with other compound semiconducting materials. The development of prototype green LEDs on undoped substrates has allowed verification of the relationship between substrate quality and device lifetime.

THERMAL BARRIER COATINGS WORKSHOP

On March 28-29, 1995 NIST, NASA, and DOE coorganized and sponsored a two-day workshop on the status of ceramic thermal barrier coatings (TBCs). The objective of the workshop was to benchmark the status of these materials through invited presentations by industrial, academic, and government researchers; processors; and designers. More than 200 attendees participated and proceedings will be issued. Following the workshop, government and industrial sponsors and participants in research and development involving these materials formed an interagency working group for the purpose of exchanging programmatic information. Yearly meetings of the interagency group are planned. The next TBC workshop will be held in 1997.

NIST WORK FEATURED AT AUTOMOTIVE CONFERENCE

The Liquid Composite Molding program at NIST was featured at the ASM/ESD International Advanced Composites Conference and Exhibition in Detroit, MI. A report of the conference in the February issue of Plastics Technology highlighted NIST advances in on-line process control and in-mold monitoring. Sensors for in-mold monitoring are important to the development of large liquid molding processes because real-time flow and cure information is essential to understand and control the process. NIST scientists developed a fluorescence sensor based on evanescent wave fiber optics to monitor the flow and cure of resin in a mold. The NIST sensor simplifies the process interface to a single optical connection, while still providing sensor information from various locations throughout the mold.

According to the Plastics Technology article, the lack of on-line process control is identified as one barrier to implementation of liquid composite molding in demanding, higher-volume applications areas, such as automotive parts. The aim of the NIST on-line process control work is to develop a control methodology capable of relating processing parameters such as resin flow, viscosity, cure rates, temperature, and pressure to final part properties. The approach incorporates a model-based high-level control system. The model-based controller is divided into an off-line component, in which the intensive non-linear computations are performed, and an on-line component that performs only linear computations or table lookup operations. In addition, a neural network-based control system also is under investigation at NIST.

THERMAL BEHAVIOR OF POLYMER ULTRATHIN FILMS

NIST Scientists report the first observations of the thermal properties of an ultrathin polymer film that is strongly attached to a substrate. Ultrathin polymer films deposited on dissimilar materials are a common feature of integrated circuits where they provide electrical insulation. Thus far, designers of microelectronic devices rely on materials data obtained from bulk property measurements even though it is suspected that the properties of materials in the size scales in actual products may differ from those of the bulk. Of particular interest to designers is the thermal expansion behavior of polymers. The high thermal expansion of polymers as compared to those of silicon or metals may lead to debonding during thermal excursions.

Scientists were able to show from x-ray reflectivity measurements that when the polymer has a strong chemical affinity for the surface, as with poly-(2)-vinylpyridine on acid-cleaned silicon, then the polymer at the surface responds differently to temperature than the rest of the material. It is found that the coefficient of thermal expansion decreases with decreasing film thickness to a minimum value at thicknesses of approximately 20 nm. This corresponds to the physical dimension of an isolated polymer molecule. The results imply a region near the interface where the thermal expansion is significantly smaller than the rest of the film. This finding shows that the mismatch of coefficients of thermal expansion at the interface between dissimilar materials is altered by the forces of attraction between the materials. Such phenomena are important to consider in computational models used to predict the stresses which develop in electronic packages when subjected to temperature change during manufacture and use.

THERMAL DIFFUSIVITY MEASUREMENTS IN MULTILAYER THERMAL BARRIER COATINGS

The high thermal resistance of interfaces in multilayer thin films permits the design of ultrathin, ultralight thermal barrier coatings that are better insulators than either of the material components used. To make a quantitative determination of the effectiveness of multilayers as thermal barriers, NIST scientists have developed a laser flash system for measuring their thermal diffusivities at sample temperatures from 1000 °C to 2500 °C, simulating the high temperature environment encountered in commercial applications. A ''Q-switched'' laser pulse and fast electronics give a response time of less than 1 μs , permitting the study of thermal barrier coatings that are only micrometers thick.

NSF RENEWS SUPPORT FOR THE CENTER FOR HIGH RESOLUTION NEUTRON SCATTERING

Through a 1989 cooperative agreement establishing the Center for High Resolution Neutron Scattering (CHRNS) at NIST's Cold Neutron Research Facility (CNRF), the National Science Foundation has supported, for use by the general scientific community, the development and operation of two state-of-the-art neutron scattering instruments with broad application in materials research. The CHRNS comprises a 30 m, high-resolution, small-angle neutron scattering (SANS) instrument, for the characterization of nanoscale structure in a wide range of materials, and a spin polarized inelastic neutron scattering (SPINS) spectrometer, a powerful probe of low-frequency dynamical processes in condensed matter. Over 150 visiting scientists have used the CHRNS SANS instrument in its nearly 2 years of operation, making it the most heavily utilized instrument at the CNRF by visiting researchers.

The NSF recently completed a thorough review of the progress of the CHRNS and, as a result, has agreed to continue and expand its support. Under the terms of a new, 5 year cooperative agreement, the NSF will continue to provide support for the staff and equipment needed to operate the SANS and SPINS instruments as user-oriented facilities, and will, in addition, provide one-half of the support required to build and operate a new double perfect crystal diffractometer (DCD) for very-high-resolution SANS. The DCD will extend the upper size limit of the 30 m SANS instrument by more than one order of magnitude, to nearly 10 μm, to provide overlap and complementarity with optical techniques. Up to 75 % of the beam time on the CHRNS instruments is allocated based solely on the scientific merit of submitted proposals that undergo external peer review.

NIST DEVELOPS NEW METHOD FOR MEASURING REFRIGERANT FLAMMABILITY

Under sponsorship of the Air Conditioning and Refrigeration Technology Institute and the U.S. Department of Energy, a NIST team has developed an improved approach to determining the flammability properties of potential alternative refrigerants. Commonly used, nonflammable chlorofluorocarbons are no longer acceptable due to their deleterious effect on stratospheric ozone. In the search for replacements, some of the candidates pose a potential fire hazard. Both the involved industries and the U.S. Government recognized the need for reliable determination of the ignitability of a refrigerant that has leaked into the ambient environment. A recent study showed that the conventional test method, ASTM E-681, is subject to excessive variation and some risk of explosion. NIST scientists, and a student at the University of Maryland have shown that an alternative approach can reduce the variation while providing for easier measurement of the key property, the lean flammability measurement. In ASTM E-681, a closed vessel is filled with a refrigerant/air mixture. Following generation of a central spark, the tester observes whether a flame propagates to the wall of the vessel. The new method uses a premixed, opposed-flow diffusion flame. Two jets of premixed refrigerant (or any other fuel) and air are directed at each other, forming a stagnation plane with twin flames on either side. The fundamental ignition properties of the refrigerant are the lean and rich flammability limits at zero flame strain, i.e., the lowest and highest flame-propagating concentrations of refrigerant in air in a totally quiescent environment. One cannot establish a zero strain rate flame, so the limits at various measured strain rates are extrapolated to zero. The flame's strain rate is varied by changing the flow velocities. The method safely produces flammability limit data that is unambiguous and of reduced uncertainty. Continuing work will reduce the uncertainty further, refine the apparatus and procedure, and minimize the amount of refrigerant needed for the determination.

NIST PARTICIPATES IN DEVELOPMENT OF REMOTE DATABASE ACCESS STANDARD

NIST has been active for a number of years in the development of the International Standard for Remote Database Access (RDA), ISO/IEC 9579:1993. The standard is a foundation for building a logically integrated database of diverse data stored in geographically separated data banks under the management and control of heterogeneous database management systems. With the RDA standard and its associated specialization for Database Language SQL, ISO/IEC 9075:1992, diverse data managers are able to communicate with one another and provide shared access to data and data operations and methods under appropriate security, integrity, and access control mechanisms

To encourage commercial development of RDA implementations, NIST joined with the U.S. Naval Research and Development Laboratory (NRaD), and others, to establish an RDA Testbed at NIST. Major goals of this testbed are to demonstrate RDA interoperability of a wide variety of client and server products, to incorporate solutions over both Open Systems Interconnection (OSI) and Internet communications transport mechanisms, to provide technical solutions for application areas, to demonstrate the integration of legacy data into modern data management applications, and to develop proposed implementor agreements in areas beyond the scope of the formal standards.

To achieve these goals, NIST is building on NRaD's research and development work for the Distributed Query Processor (DQP), the RDA Client, and the RDA Server. Building on NRaD's research work saved at least 3 years in bringing RDA to fruition. Additionally, having access to NRaD's Server node on the West Coast from NIST's Client node on the East Coast, NIST can show to many potential RDA users the value of real-time interoperability. To date, NIST has demonstrated RDA to more than 40 industry organizations, government agencies, academic institutions, and industry consortia.

SECRETARY OF COMMERCE APPROVES FEDERAL INFORMATION PROCESSING STANDARD (FIPS) FOR DOCUMENT APPLICATION PROFILE

FIPS 194, Office Document Architecture (ODA) Raster Document Application Profile (DAP), has been approved for federal agency use. FIPS 194 adopts the International Organization for Standardization (ISO)/ International Electrotechnical Commission (IEC) 12064-1 International Standard Profile (ISP) FOD112, Open Document Format: Image Applications—Simple Document Structure—Raster Graphics content architecture, Part 1: Document Application Profile (DAP). The FIPS adopts a functional profile or DAP which is a subset of the ODA standard. The DAP was initiated by an ad hoc task group for the Continuous Acquisition and Life Cycle Support (CALS) program. Effective Sept. 1, 1995, FIPS 194 will enable federal agencies to exchange formatted structured documents between systems designed for raster graphics applications.

NEW PUBLICATION LOOKS AT OBJECT-ORIENTED TECHNOLOGY

NISTIR 5600, Object-Oriented Technology Research Areas, discusses some of the issues surrounding object technology, including object-oriented development methodologies, measuring the quality of object-oriented software, testing, the use of object-oriented technology in high-integrity systems, and distributed object computing. The report identifies research topics in object-oriented technology for NIST.

INFORMATION SECURITY TRAINING ATTRACTS LARGE FEDERAL AUDIENCE

On March 29-30, 1995 NIST co-sponsored the Invitational Workshop on Information Technology (IT) Security Techniques and Tools for Government Information Technology Services. Co-sponsors included Defense Information Systems Agency, General Services Administration, Government Information Technology Services Working Group, and National Communications System. More than 200 federal participants attended the workshop.

The goal of the workshop was to assist agencies in meeting their current information technology security requirements by facilitating the exchange of information among agencies regarding solutions to the security challenges they face. Sessions ranged from the Office of Management and Budget presentation outlining the revisions to OMB Circular A-130 to the Central Intelligence Agency briefing on implementing Lotus Notes in a secure environment. NIST presentations included firewalls, an overview of the Forum of Incident Response Teams (FIRST), the use of standards in acquisitions, an update on the Computer Security Resource Clearinghouse, and the upcoming publication of the NIST Security Handbook. Several agencies also demonstrated security products or tools they were implementing. NIST demonstrated the Computer Security Resources Clearinghouse and an implementation example of a digital signature.

NVCASE PUBLIC WORKSHOP HELD

The Office of Standards Services held a public workshop on the National Voluntary Conformity Assessment Systems Evaluation (NVCASE) Program on March 9 to describe the operation of the program and to obtain public input regarding the development of generic criteria for evaluating applicants.

NIST proposed use of ISO/IEC documents, e.g., Guides 25 and 58, for laboratory accreditation applications; draft CASCO 226 and 227 for quality system registration applications; and draft CASCO 226 and 228 for product certification applications. The 40 workshop participants generally agreed with these proposals. Copies of the CASCO documents were distributed, and comments regarding implementation were requested.

To date, four organizations have requested evaluation under NVCASE: the American National Standards Institute (ANSI) applied for recognition of its product certification accreditation program for selected industrial sectors; ANSI also requested recognition for its joint program with the Registrar Accreditation Board as an accreditor of quality system registrars; the American Association for Laboratory Accreditation applied for recognition as an accreditor of testing laboratories for EMC and telecom terminal equipment; and the National Marine Manufacturers Association requested NVCASE accreditation as a certification body for recreational boats and accessories. These applications are being processed, including consideration of public comments.

CALIBRATION ACCREDITATION

The National Voluntary Laboratory Accreditation Program (NVLAP) has issued its first certificates and scopes of accreditation under its new Calibration Accreditation Program (CALLAB). The following laboratories were accredited as of April 1: the Georgia Department of Agriculture Weights and Measures Laboratory, accredited for mass and volume; the Oak Ridge Metrology Center, accredited for step gages and end gages using a coordinate measuring machine; Rice Lake Weighing System, accredited for mass; and the Southern California Edison Metrology, accredited for DC voltage and mass. Two laboratories previously accredited under the NVLAP Secondary Calibration Ionizing Radiation Program were accredited under CALLAB. They are the Center for Devices and Radiological Health X-Ray Calibration Laboratory and the Pacific Northwest Laboratory, each accredited for Ionizing Radiation.

CRYPTOGRAPHIC MODULE VALIDATION

The National Voluntary Laboratory Accreditation Program has announced a program to accredit independent third-party laboratories to test cryptographic modules. NIST and the Communications Security Establishment of the Government of Canada have developed a conformance test method to validate products to Federal Information Processing Standard (FIPS) 140-1, ‘‘Security Requirements for Cryptographic Modules.’’ Products found to conform to the standard will be accepted for use both by U.S. federal agencies and the Canadian government for the protection of sensitive, unclassified information. Details about the NIST Cryptographic Module Validation Program are available from NIST.

PATENT ISSUED ON THE APPLICATION OF ARRAYS OF MINIATURE HOTPLATES TO MATERIALS PROCESSING

NIST scientists have been awarded a second patent number (5,356,756, Application of Microsubstrates for Materials Processing) relating to the design, manufacture, and use of arrays of miniature hot plates, originally developed to test infrared imaging systems. NISTscientists collaborated to develop miniature devices capable of analyzing chemical mixtures. The devices are manufactured by standard complementary metal oxide-semiconductor foundry techniques, which allow the production of a range of devices that have improved sensing performance. The last etch step is carried out locally.

The patent describes a procedure to use an array of miniature hotplates to separately, but simultaneously, process deposited films. The key to the wide range of potential applications is that the temperature of each hotplate can be controlled separately both in an initial film deposition step and later in use (for example, as a sensor for a specific gas). Properties of the film elements may be measured using electrical contact pads. The array of processed films may be used for sensors, electronic devices, greatly accelerated materials development processes, and solid-state physics, biology, and chemistry studies.

LATEST GAGE BLOCK CALIBRATION SYSTEM AT NIST

A NIST scientists successfully completed a new calibration system for the NIST Gage Block Laboratory. The user-friendly system allows NIST laboratory personnel to routinely carry out a substantive measurement assurance program using efficient and practical stand-alone PC-based workstations for all NIST reference standard master gage blocks. With present measurement designs, typical uncertainty estimates for steel gage block calibrations by mechanical intercomparison are 25 nm for gage block sizes shorter than 50 mm and between 28 nm to 122 nm for sizes 50 mm through 500 mm. These figures reflect a steady reduction over past years and are in part a direct result of improved and frequent surveillance of the complete NIST gage block calibration history. The new system continues to use a special database and exclusive analysis software to record and monitor customers' gage block measurement histories, reduce risks of reporting inaccurate measurements, and improve complete measurement confidence.

NIST ASSERTS NEW APPROACH TO UNIFYING ROCKWELL HARDNESS STANDARDS

An ISO Technical Committee meeting on Rockwell hardness standards (ISO/TC164/SC3) was held March 28-29, 1995 at NIST. Two NIST scientists were invited to attend as non-voting delegates. The delegates visited the NIST Rockwell hardness calibration laboratory, as well as the NIST surface and microform calibration laboratory. A round-table discussion on the strategy of unifying international Rockwell hardness standards was also held on March 27 before the committee meeting. In that discussion, a NIST scientist pointed out that the unified European Rockwell Hardness Standard Scale is a ''performance-based standard system'' with the following disadvantages: it does not have traceability to fundamental metrology; and it has an unknown systematic offset with respect to a ''properly defined'' Rockwell hardness scale.

The NIST approach of establishing a ''Metrology-Based Standard System'' to unifying international Rockwell hardness standards also was introduced. According to the NIST approach, the ''properly defined'' scale is established through fundamental metrology. The metrology-based Rockwell hardness reference standards include a standard dead-weight testing machine (developed by the Instituto di Metrologia ''G. Colonnetti,'' Italy, and in operation at NIST) and a standard class of Rockwell diamond indenters, which are more tightly controlled for dimension and form than previous classes of such indenters. These indenters are to be measured with a high-accuracy microform calibration system, such as the one developed at NIST. Their uncertainties are established through procedures recently developed at NIST. The testing machine and the indenters are used to create, maintain, and reproduce the Rockwell hardness scale and to unify the international Rockwell hardness standards.

The response to the NIST approach was positive. It was suggested that a subcommittee be formed to investigate the NIST approach. In addition, extensive testing of the microform and the performance of several types of indenters, including those from Italy, Germany, Japan, and the United States, was initiated during the meeting. A research paper entitled ''A Metrology Approach to Unifying Rockwell Hardness Standards'' by three NIST scientists has been accepted by the International Hardness Conference to be held in Germany in November 1995.

FIRST TECHNICAL MEETING OF COMPUTER-AIDED MANUFACTURING FORUM HELD

The Computer-Aided Manufacturing Engineering Forum held its first technical meeting in Gaithersburg, MD March 21-22, 1995. The focus of the meeting was a review of requirements for the Navy-sponsored Manufacturing Engineering Tool Kit (METK) project. The METK will integrate commercial product data management, process planning, and manufacturing simulation systems. The technical focus of the project is validating engineering data using simulation.

Working sessions at the forum meeting prioritized the machines and processes to be included in a simulated machine shop, specified types of errors that most often occur in engineering data, and identified mechanisms for detecting and correcting errors. A draft proceedings of the meeting has been prepared and will be published as a NISTIR.

INTERNATIONAL COMPARISON OF HUMIDITY STANDARDS AT NIST

In collaboration with the Instituto Nacional de Tecnica Aeroespacial (INTA) of Spain, NIST has begun an international comparison of humidity measurement standards. A representative of INTA, the Spanish agency devoted to aerospace research and technological development, visited NIST for preliminary comparison of standards in anticipation of the intercomparison for the European Union (EU) region.

A precision optical dew-point hygrometer, provided by INTA for use as a transfer standard for the EU region, was calibrated in the NIST Two-Pressure Humidity Generator, which is currently the NIST humidity calibration standard for dew-points in the range from –70 °C to 40 °C. This INTA hygrometer, with repeatabillity of better than ±0.01 °C, was previously calibrated in the National Physical Laboratory (NPL) Two-Temperature Humidity Generator in Great Britain. For dew-points above –20 °C, the NIST and NPL calibrations are in excellent agreement, with discrepancies in dew-point temperature no larger than 0.03 °C. In this range the expanded uncertainty of the NIST standard is ±0.04 °C while that of the NPL standard is ±0.06 °C. For dew-points below –20 °C, the discrepancy between the NIST and NPL calibrations increases to a maximum of 0.25 °C at –70 °C, where the expanded uncertainty of the NIST standard is ±0.10 °C while that of the NPL standard is ±0.11 °C. Since this discrepancy is not expected to be associated with the transfer standard, there is a strong motivation for further testing and intercomparisons.

As part of the current phase of the international omparison of humidity standards, comparisons using the INTA instrument will be conducted among the EU national laboratories of Germany, France, Italy, the Netherlands, and Spain. In the North American region, NIST will provide a precision dew-point hygrometer for use as a transfer standard for comparisons in Canada and the United States. In the Asian-Pacific region, an intercomparison is being organized with the national laboratories of China, Hong Kong, Japan, Korea, Malaysia, New Zealand, Singapore, Taiwan, and Thailand. A dew-point hygrometer from Singapore will be used as a transfer standard. The second phase of the intercomparison will be the testing of the three regional instruments at NIST.

SYNTHESIS AND IN SITU CHARACTERIZATION OF SUPERPARAMAGNETIC NANOCOMPOSITES FROM VAPOR PHASE CONDENSATION IN A FLAME

Recent work on the magnetic characteristics of nanometer-scale materials has suggested that such materials have novel properties which vary with size. In particular, magnetically isolated nanometer magnetic particles show superparamagnetic behavior rather than the ferromagnetic behavior found in bulk. Such behavior has been demonstrated to be important for magnetic refrigeration applications. Because of expensive production techniques, it is desirable to find a single method that not only synthesizes these materials in sufficient quantities for study but also allows the isolation of the magnetic particles from each other via encapsulation within a non-magnetic host.

To this end NIST has investigated application of flame growth technology for the synthesis of this class of materials. A pre-mixed methane/oxygen flame diluted with nitrogen is used as the reacting environment in which iron carbonyl and hexamethyldisiloxane is added as the magnetic and nonmagnetic precursor materials. The regulation of the combustion process enables the control of the morphology and chemical composition of the resulting composite particles so that:

- Nanometer composite particles are formed containing 5 nm to 10 nm $Fe_3O_4/\gamma\text{-}Fe_2O_3$, encased in a silica particle whose diameter ranged from 30 nm to 100 nm depending on loading and flame temperature.
- The iron oxide clusters are magnetically isolated and show superparamagnetic behavior.

In-situ characterization of both vapor phase species as well as the particle phase has been conducted using 2-D laser-induced fluorescence and MIE imaging in order to better understand how to control the process.

The results indicate that particle nucleation of the ironand silicon components occurs independently, which allows for the formation of the encapsulation process.

COMPUTATIONAL THERMOCHEMISTRY OF $Si_xH_yO_z$ REACTIONS

Scientists at NIST have produced the first set of data using ab initio molecular orbital calculations for more than 60 silicon-oxy-hydride species and transition states for reactions important to silane combustion and chemical vapor deposition of SiO_2 in the semiconductor manufacturing industry. Geometries, vibration frequencies, and heats of formation for both equilibrium and transition state species have been obtained using a bond additivity corrected procedure to calibrate molecular orbital calculations. The correction procedure allows the use of a lower level of ab initio theory, necessary to obtain a large body of data, while still obtaining the needed accuracy. Furthermore, this new approach allows a systematic generation of a self-consistent set of thermochemical and kinetic data when no substantial experimental data are available. From the calculated transition state properties, rate expression for some 40 reactions have been derived from well-known master equation solutions. The derived thermochemistry and kinetics form the basis from which a comprehensive detailed chemical kinetic model may be built for subsequent reactor simulations.

ROLE OF RADIOCARBON MEASUREMENT TECHNOLOGY IN MEETING URBAN AIR QUALITY STANDARDS

Urban areas in the United States that fail to meet the National Ambient Air Quality Standards (NAAQS) are required by the Clean Air Act to implement control strategies. A common approach to identifying sources of ambient pollutants is to study their spatial and temporal distributions and compare these concentrations to source profile concentrations using various modeling techniques. The models used to estimate the impact of emission sources on ambient air quality generally rely on assumptions and must be tested and validated. Radiocarbon analyses provides definitive data for evaluating carbon models that rely heavily on chemical information and/or surrogate tracer species only. Over the past 2 decades, NIST has been a leader in advancing the state of separation science and radiocarbon isotopic measurements using accelerator mass spectrometry on small (sub milligram) environmental samples to discriminate quantitatively fossil from contemporary carbon.

Recently, NIST researchers have applied radiocarbon measurement technologies to assist local municipalities in quantifying major carbonaceous pollutant sources during episodes when carbon monoxide concentrations and aerosol exceeded their respective NAAQS. These studies included: (1) carbon monoxide concentrations in Albuquerque, NM, where mandatory no-woodburning days had been implemented as a CO emission control strategy; (2) wintertime sources of PM10 aerosol in Denver, CO, which in 1992-1993, 1995 had failed to meet the NAAQS for the first time since 1987; and (3) ^{14}C characterizations of primary sources that contribute greater than 80 % of the ambient carbon aerosol mass in Los Angeles.

Radiocarbon results for the Albuquerque study indicated that fossil CO was the dominant source of ambient CO, and in Denver that fossil carbon was the dominant source of carbon. In Los Angeles, emission inventories constructed based on ^{14}C measurements indicated that several anthropogenic sources, e.g., fireplaces and charbroilers, emit significant quantities of contemporary carbon. These data, combined with meteorological data, were used to evaluate an atmospheric transport model. Overall consistency between model predictions and ambient ^{14}C measurements was demonstrated. Results of these studies will be used by state and local agencies responsible for developing future emission control plans.

EIGHTH ANNUAL WORKSHOP ON SECONDARY ION MASS SPECTROMETRY

The 8th Annual Workshop on Secondary Ion Mass Spectrometry (SIMS) was held in Lake Harmony, PA, May 7-10, 1995. This yearly workshop is organized by NIST, the Naval Research Laboratory, and the Army Research Laboratory. This year the workshop was attended by close to 100 SIMS researchers from the United States, Canada, and Europe.

The first day of the meeting was devoted to invited tutorial presentations given by noted experts on various aspects of SIMS and related techniques. Topics included molecular dynamics simulations of sputtering, ionization effects, semiconductor characterization, isotope ratio analysis, biological analysis, organic analysis, ion source design, and the use of focused ion beam systems for materials characterization. The second day of the workshop was devoted to new developments in SIMS instrumentation, which included sessions on instrumental repair and troubleshooting and tutorials on instrument operation. The final day of the meeting was devoted to contributed presentations on various aspects of SIMS, including isotopic ratio analysis, laser post-

ionization, semiconductor characterization, and analysis of organic molecules. It was announced at this meeting that the organizers of the SIMS Workshop would be hosting/organizing the 11th International Conference on SIMS to be held in 1997 at a site as yet to be determined.

WORKSHOP ON INFRARED MICROSPECTROSCOPY WITH SYNCHROTRON RADIATION SOURCES

Infrared microspectroscopy has become a widely used analytical technique for determining the chemical composition of small samples and for elucidating the relationship between chemical properties and microstructure of materials. The technique involves the spectroscopy of very small samples using an infrared source of radiation, a low-resolution Fourier transform spectrometer, and an infrared microscope. Several thousand infrared microscopes are in use around the world, in forensic and pathological analysis, mineralogy, polymers science, and many other applications. Synchrotron radiation can be several orders of magnitude brighter than the conventional sources used for infrared microscopy. Recent work at the National Synchrotron Light Source (NSLS) has shown that this higher brightness can be achieved in a standard commercial microscope interfaced to a synchrotron beamline.

The surge of interest in this approach led NIST to sponsor a one-day workshop on infrared microscopy with synchrotron radiation, May 4, 1995, with the goal of gauging interest by the user community in a microscope facility at the NIST SURF II Synchrotron Ultraviolet Radiation Facility. The workshop drew a diverse mix of 50 participants, with representatives from private industry and Government agencies among others. Independent studies reported by NIST and by NSLS indicated that SURF II has excellent prospects as a infrared source for microspectroscopy. The workshop resulted in the formation of a users' group that will provide input to the design of a microscope facility at SURF II; this group also was offered a block of beam time at the NSLS facility so that its members can accumulate experience in working at a synchrotron facility.

OCEAN RADIOMETRY WORKSHOP AT NIST

On May 3-10, 1995 NIST and the National Aeronautics and Space Administration co-hosted the fourth SeaWiFS Intercalibration Round-Robin Experiment (SIRREX-4). SeaWiFS (Sea-viewing Wide Field-of-view Sensor) is an ocean color radiometer that will launch in the near future with a five-year mission to determine the water-leaving radiances and chlorophyll-a concentrations in the world's oceans. The accuracy of the results are critically dependent on the accuracy of multiple in situ field measurements. This year SIRREX focused on the techniques and procedures NIST uses to calibrate and characterize radiometric artifacts (principally lamps, spheres, and plaques). Presentations made by NIST scientists were organized as lectures that set the stage for afternoon ''practicals.''

Other presentations laid out the requirements of several national and international ocean color projects. In addition to SeaWiFS, scientists associated with the U.S. moderate resolution imaging spectroradiometer, the German marine optical spectroradiometer, the Japanese ocean color temperature sensor, the European medium resolution imaging spectrometer, and the Taiwanese ocean color imager projects briefed the participants on their individual projects and calibration requirements. Scientists working in the field projects in support of these missions, e.g., the Pan-European investigations into calibration of atmosphere and sea surface optics and the Plymouth atmospheric correction experiment also presented their plans and current capabilities.

CRADA INVESTIGATES RADIATION ENGINEERING FOR ENVIRONMENTAL CLEANUP

Under a Cooperative Research and Development Agreement between NIST and the University of Maryland Department of Materials Science and Nuclear Engineering, NIST scientists are using the Medical-Industrial Radiation Facility (MIRF) to investigate the feasibility of electron-beam treatment of wastes and environmental contaminants. With support from the Environmental Engineering Division of the National Science Foundation, the University of Maryland is using high-energy electrons to destroy halogenated hydrocarbons and to precipitate toxic heavy metals from waste streams.

The faculty researchers and graduate students on this project are using high-energy electron beams (7 MeV to 32 MeV) from the MIRF electron linac, as well as 2 MeV electrons from our 50 ns pulsed Febetron accelerator. After irradiation of the halogenated hydrocarbons (PCBs), measurements are made on the degradation products by mass spectrometry. Preliminary measurements suggest that the high-energy electrons offer an effective method of dechlorinating halocarbons in thick samples. A novel irradiation design also is being tested for solutions of heavy metals such as lead. Preliminary results of irradiating lead solutions with 16 MeV electrons are very encouraging.

NIST ASSISTS INDUSTRY IN THERMOPLASTICS ENGINEERING DESIGN

Research engineers from two major U.S. companies recently met with NIST researchers to discuss needs in data and constitutive modeling. The two companies are collaborating to develop better methods for designing molds for injection molded parts. A major thrust of the work involves developing superior methods of estimating residual stresses imparted in molded parts during the molding process in order to avoid warpage and shrinkage errors and premature failures. In particular, significant savings are possible if molds can be designed ''right the first time'' to avoid expensive, iterative rework of the molds.

Currently, researchers from the two companies are performing computer simulations assuming a linear visco-elastic material behavior to estimate part dimensions and molded in stresses. As a result of the meeting, NIST will provide data on the viscoelastic response of a model polycarbonate material being used in the joint program. The data obtained by NIST will be used in the computer simulations and the results compared directly with the two companies experiments using a one-of-a-kind instrumented mold. NIST scientists briefed participants on concurrent work at NIST that addresses limitations of prevailing simulation models arising from the assumption of linear viscoelastic material behavior. The NIST work uses finite-element modeling with advanced constitutive equations for the same polycarbonate material and develops efficient means to use laboratory experiments to obtain materials data in the non-linear regime of mechanical behavior.

METHOD DEVELOPED TO MEASURE MATERIAL DENSITY AT SURFACES

Scientists at NIST have developed a technique that improves the accuracy in measuring the density of materials at flat surfaces by at least a factor of five. The technique uses the reflection of x rays to determine density to a depth on the order of tens of nanometers. The method is expected to be particularly useful in the study of thin dielectric layers used in microelectronics. Density is a property that is often critical in determining performance in service. However, near-surface and thin-film density is difficult to measure, primarily due to the small amount of material involved. The new method could be adapted to measure density in situ during film deposition and, thus, serve as a useful process diagnostic.

Currently, the most direct way to measure near-surface density is single-wavelength x-ray reflectivity. The uncertainty in the density determination by this method is largely controlled by the alignment of the sample with respect to the incident x-ray beam. For example, a misalignment of 2×10^{-4} rad in sample tilt can change the measured density by 10 % of the density. Methods to improve sample alignment are possible, but would be tedious and difficult to implement. NIST scientists have demonstrated that a fivefold improvement in accuracy can be attained by measuring the x-ray reflectivity at many different wavelengths simultaneously. This is accomplished by replacing the conventional detector with an energy-dispersive detector. Misalignment of the sample will result in a different calculated density for each wavelength, but the extrapolation of the resultant density-versus-wavelength to infinite wavelength yields the correct value. The technique has been tested successfully on samples with well-characterized densities, e.g., silicon single-crystal surfaces, as well as on thin films with unknown densities, e.g., spin-on-glass dielectrics. Discussions are under way with a major manufacturer of x-ray reflectivity instrumentation to incorporate this measurement technology into commercial instrumentation.

MICROMAGNETIC MODELING WORKSHOP

The micromagnetic modeling activity group, sponsored by NIST held a workshop in conjunction with the 1995 IEEE International Magnetics Conference. The purpose of the workshop was to bring together representatives from industry, academia, and government labs to address fundamental problems and challenges in micromagnetic modeling. The field of micromagnetics is concerned with the configuration of magnetic moments in magnetic domains and domain walls on a mesoscopic scale, which is larger than the atomic length scale but is too small to be adequately described by bulk material properties.

The digital data storage industry relies on micromagnetic modeling for the design of read/write heads and media for high-density magnetic data storage, and other industries use micromagnetic modeling for the design of magnetic field sensors for a variety of commercial applications.

The workshop drew an estimated 100 magnetism experts from around the world, and fully half of the 30 people indicating interest in further participation were from U.S. companies. Three main needs were identified: the need for accurate materials data, the need for quantitative checks for micromagnetic computer code development, and the need for portable public code for micromagnetic calculations. In response to this discussion, two working groups, which will include industrial, academic, and government scientists, are being formed.

NIST RESEARCHERS RECEIVE PATENT FOR A WELDING CONTROL SYSTEM

Patent 5,349,156, ''Sensing of Gas Metal Arc Welding Process Characteristics for Welding Process Control,'' was granted to two NIST researchers. The patent covers a system to sense and control the arc length in gas metal arc welding, a dominant welding process, with yearly sales of more than 100 000 000 kg of welding electrode. The system goes beyond previous technology by combining a light intensity sensor (to measure the arc intensity) with a current sensor (to correct for changes in the arc diameter). Tests show that the system is able to control the arc length to within 1 mm, when the contact-tube-to-work distance changes by 10 mm. Such precision in an automatic sensor allows robotic production lines to correct for part variations and distortion, leading to higher quality and fewer rejects. This system will be added to the previously developed arc sensing and control systems that are being evaluated for industrial applications under Cooperative Research and Development Agreements with two private companies.

NIST HOSTS JOINT MEETING WITH NSF CENTER FOR SCIENCE AND TECHNOLOGY OF ADVANCED CEMENT-BASED MATERIALS

A joint meeting of the National Science Foundation Center for Science and Technology of Advanced Cement-Based Materials (ACBM) and the NIST High-Performance Construction Materials and Systems Program was held April 5-6, 1995. The primary objective was to introduce industry to the latest developments in cement and concrete materials research that could provide the technical basis for new products with significant commercial potential.

The meeting was attended by more than 50 individuals representing the 18 industrial affiliates of the ACBM, federal agencies, Washington, DC-based industry organizations, as well as NIST and ACBM researchers. ACBM is a consortium of Northwestern University, the University of Illinois, the University of Michigan, Purdue University, and NIST.

The agenda included 15 technical presentations on both center and NIST projects, including those by NIST staff. These addressed the following topics: hydration and shrinkage of cements; concrete rheology; mechanisms of transport and environmental degration; compositional and phase analysis of cement-based materials; performance of fiber-reinforced concrete composites; and mechanical testing, structural performance, and field curing of high-strength concretes.

NIST MODELS RADON TRANSPORT IN LARGE MULTIZONE BUILDINGS

NIST has performed computer simulations of airflow and radon transport in four large buildings using the multizone airflow and indoor air quality model CONTAM developed at NIST. These buildings include a 12-story multifamily residential building, a five-story mechanically ventilated office building with an atrium, a seven-story mechanically ventilated office building with an underground parking garage, and a one-story school building. These simulations were performed to study the impact of weather conditions, building characteristics, and ventilation system design and operation on radon entry rates and indoor radon concentrations.

One important finding of this effort is the importance of vertical shafts, such as elevators and stairways, in transporting radon from ground-contact floors to the upper floors of a building. When the indoor air temperature is above the outdoor temperature, air will tend to flow into these shafts on lower floors and out on upper floors. This airflow pattern will result in low radon concentrations on the first few floors of a building and elevated concentrations on the upper floors. In addition, unexpected relationships between building pressure and wind speed were found when mechanical ventilation systems were operating.

The project was not undertaken to estimate human exposure to radon but instead to demonstrate the ability of these models to account for the complexities of airflow and contaminant transport in multizone building systems. The CONTAM program provides designers and others with new capabilities for predicting ventilation rates and indoor pollutant concentrations at a high level of technical sophistication and with an extremely user-friendly interface. In the future, designers, equipment manufacturers, and others involved in the construction and operation of buildings will use these programs to predict indoor pollutant levels, make decisions on building equipment and furnishings, and implement indoor air quality controls. The results of this effort, performed for the Office of Radiation and Indoor Air of the U.S. Environmental Protection Agency, are reported in NISTIR 5611, Computer Simulations of Air Flow and Radon Transport in Four Large Buildings.

FAULT DETECTION AND DIAGNOSIS USING ARTIFICIAL NEURAL NETWORKS

NIST researchers have completed preliminary research on fault detection and diagnosis (FDD) of building mechanical systems. This was done collaboratively with

researchers from 10 countries to evaluate a wide variety of FDD methods using simulation studies, laboratory test rigs, and real building data. Applications have included variable air volume (VAV) air handling systems, chillers and heat pumps, oil burners and boilers, district heating systems, and thermal storage systems.

One of the most promising methods investigated is the use of an artificial neural network (ANN) for FDD of a VAV air handling unit. The approach involves selecting a set of residuals of system variables that can be used to quantify the dominant symptoms of different fault modes of operation. The residuals are normalized, and idealized steady-state patterns of these normalized residuals are used to define each mode of operation. The steady-state relationship between the dominant symptoms and the faults are learned by an ANN using a back-propagation algorithm. The ANN network is then applied to real data and identifies both normal and abnormal operation and the type of fault when one arises. The method has been applied successfully to both simulated and laboratory data and has been implemented on a real VAV air handling unit in a NIST laboratory. Eight types of faults have been studied to date. The results have been very encouraging. Future research will develop separate ANNs for each mechanical subsystem and use an expert system to identify the appropriate subsystem to examine the existence of faults.

PROCEEDINGS OF TEXT RETRIEVAL CONFERENCE PUBLISHED

NIST Special Publication 500-225, Overview of the Third Text REtrieval Conference (TREC-3), presents the proceedings of a workshop held in November 1994 in Gaithersburg, MD. Co-sponsored by NIST and the Advanced Research Projects Agency, TREC-3 was the third in an ongoing series of workshops, which bring together researchers to explore different approaches to searching and retrieving unstructured text. About 150 people involved in 32 participating research groups from industry and academia attended the conference.

Using the same large test collection in their evaluations, participants reported on a wide variety of retrieval techniques, including methods using automatic thesauri, sophisticated term weighting, natural language techniques, relevance feedback, and advanced pattern matching. Since results were obtained through a common evaluation package, groups were able to compare the effectiveness of different techniques and to discuss how differences among the systems affected performance.

NEW PUBLICATION GIVES BLUEPRINT FOR ELECTRONIC ACCESS TO HISTORICAL INFORMATION

NIST Special Publication 500-227, ELECTRONIC ACCESS: BLUEPRINT for the National Archives and Records Administration, describes an electronic access system that would allow citizens in remote areas to receive historical information maintained by the National Archives and Records Administration (NARA). The 1994 Electronic Access Study (described in NIST Special Publication 500-221) identified four priority needs of users: information on locating information and services available through NARA; a catalog of records and related material held by NARA; the capability for online ordering; and the ability to download NARA documents. NIST Special Publication 500-227 presents a blueprint for meeting these needs.

REPORT DETAILS BENEFITS OF ELECTRONIC WORKSHOP

Automating the operations of the Open Systems Environment Implementors' Workshop (OIW) resulted in substantial cost savings as well as improved timeliness and accessibility of information to the OIW membership and the public. NISTIR 5623, An Electronic Implementors' Workshop, describes the various elements of an electronic workshop and provides a list of capabilities needed to operate one. The primary requirement is use of the Internet for basic communications such as electronic mail, public forums, and distribution of publications using computer-based media.

COMMERCE, ENERGY JOIN FORCES TO AID MANUFACTURERS

The Departments of Commerce and Energy have announced the signing of two separate agreements to combine their resources to help American textile and other manufacturers improve their competitiveness, and preserve and create jobs. The memoranda of understanding build upon the success of existing technology commercialization programs. In the first, the standards development and computer-integrated manufacturing activities of NIST's Apparel Technology Program are coordinated with DOE's AMTEX Program. AMTEX is a partnership that links DOE laboratories and universities to the textile industry. The second agreement between DOC and DOE links Energy's laboratories with the NIST-managed Manufacturing Extension Partnership nationwide network of 42 centers. The joint effort will better disseminate technical information and expertise in areas including pollution prevention, waste minimization, and energy efficiency to the nation's 381,000 smaller manufacturers.

FIRST FULL-SCALE FIRE TESTS FOR HIGH CEILINGS DONE

Smoke detectors, automatic sprinklers and other fire protection systems are common sights in buildings throughout the United States. However, building codes mandating their use are limited to structures with ceilings less than 9 m in height. The reason: a lack of research data on the behavior and movement of flame, heat and smoke in high-ceiling spaces. To remedy this problem and help spur the development of fire protection systems for high-ceiling spaces, NIST is part of a research team that also includes NASA, the U.S. Navy and five fire equipment manufacturers. NASA and the U.S. Navy are concerned because many of their facilities cannot use fire plans designed for lower-ceiling structures. One towering example is NASA's 158 m Vehicle Assembly Building in Cape Canaveral, FL. Over the past 4 years, NIST researchers have created three-dimensional computer models to simulate flame, heat and smoke behavior in high-ceiling spaces. The first full-scale testing of these models, as well as prototype fire detection and suppression equipment designed for high-ceiling structures, recently occurred at Navy aircraft hangars in Hawaii and Iceland. Thirty-five fires, ranging from 0.3 sm^2 to 67.5 sm^2 in area, were studied in the hangars under varying conditions. Each fire yielded data on 200 separate measurement points. The team hopes to publish a report on the fire tests in early 1996. For technical information, contact Kathy Notarianni, B356 Polymer Building, NIST, Gaithersburg, MD 20899-0001, (301) 975-6883, e-mail: kanfpe@enh.nist.gov (via Internet).

DISTRIBUTION AMPLIFIERS YIELD LOW NOISE, HIGH ISOLATION

New low-noise amplifiers—designed for distributing standard time and frequency signals within a laboratory—have been developed by NIST and researchers at the Technical University of Torino (Italy). The devices provide exceptionally low environmental sensitivity and remarkably high isolation among all outputs and input. One model is designed for 5 MHz to 10 MHz, while another goes up to 100 MHz. These unity-gain amplifiers accept input signals of up to 1 V root-mean-square and supply five independent outputs. There is typically a 120 dB isolation between channels, and between input and outputs, which means that shorting or disconnecting one channel changes the phase of another channel by less than 40 fs at 5 MHz or 2 fs at 100 MHz. Phase delay sensitivity to temperature is less than 0.3 ps/K, resulting in a fractional frequency error of less than 3×10^{-18}/K for a measurement time of one day. This error is at least 1000 times smaller than those associated with today's frequency standards. These properties assure that the full accuracy and stability of the standard driving the amplifier is delivered to the multiple output ports, and can make the acquisition of additional standards unnecessary in some metrology laboratories. For technical information, contact Fred Walls, Div. 847.30, NIST, Boulder, CO 80303-3328, (303) 497-3207, e-mail: walls@bldrdoc.gov (via Internet).

Standard Reference Materials

SRM 2391—PCR-BASED DNA PROFILING STANDARD

DNA profiling has been a revolutionary development in the field of human identity testing. The PCR (poly-merase chain reaction) process is capable of typing biological evidence containing old, degraded, or minute amounts of human DNA, with more distinct identification of alleles, enhanced sensitivity, and greater efficiency than other conventional techniques. It has proven invaluable to the forensics, paternity testing, and molecular biology communities, and has been a focus of discussion with the FBI for several years. The technology is at a point where standards are required for universal acceptance in the legal community. To date, several court cases already have been decided based on this technology.

The Standard Reference Materials Program announces the availability of SRM 2391—PCR-Based DNA Profiling Standard. This SRM was developed with funding by the National Institute of Justice through NIST's Office of Law Enforcement Standards and the NIST Standard Reference Materials Program. SRM 2391 is intended for use by forensic and paternity laboratories for PCR-based DNA genetic testing as well as for instructional law enforcement and nonclinical research purposes.

SRM 2391 is a 20-component SRM comprised of eight well-characterized human genomic DNAs, four PCR-amplified products for the D1S80 locus, an allelic ladder for the D1S80 locus, and a 100 base-pair molecular weight ladder (known as a DNA Analysis Marker), which is calibrated with DNA band sizes that range from 100 to 1500 base-pairs of DNA.

EIGHT THOUSAND SERIES RMS FOR FINE GOLD, FINE SILVER, AND GOLD BULLION FROM THE ROYAL CANADIAN MINT (RCM)

Buyers and sellers of precious metals have traditionally turned to standardized metals as references to set commercial metal values based on purity, to resolve discrepancies, and to settle disputes between analyses. ASTM Standard Specifications B 562-86 Standard Specification for Refined Gold and B 413-89 Standard Specification for Refined Silver establish the impurity levels allowable in fine gold and fine silver, but there has been a lack of Reference Materials (RMs) having known amounts of these impurities. Precious metal RMs are critical for quality control and solid sampling analyses (such as spark ablation plasma emission analysis, x-ray florescence, and fire assay bullion analysis) used by the precious metals industry.

The Royal Canadian Mint (RCM) has formulated and characterized two series of RMs to meet this need. Additionally, the RCM has also issued a series of gold bullion RMs. The Standard Reference Materials Program has agreed to serve as the North American distributor of these three series of RCM materials.

The RCM Fine Gold RMs are available in three forms suitable for different test procedures: block (30 g), wire (25 g), and turnings (25 g). They provide the concentrations of 16 trace metals at six different impurity levels. The Fine Silver RMs, available only in block (30 g) form, provide 12 trace metal concentrations at seven different impurity levels. The Gold Bullion RMs, available in three forms: disk, foil (3.5 cm×4.0 cm), and wire (25 g), characterize gold and silver content at five different levels, and list copper content (obtained by difference) for information.

SRM 1632B, 1635 TRACE ELEMENTS IN COAL

Fluorine is an essential element in animal and human physiology. The prevention of dental caries is the element's major known role in health. Fluorine availability during crucial growth periods of bone formation may have a role in preventing osteoporosis during aging. Conversely, fluorine at overly high levels also can cause serious bone disease and the mottling or even loss of teeth. Therefore, it is important that environmental levels of fluorine be regulated carefully to maintain the element in the beneficial, even essential, range of concentrations. Coal burning is one means by which fluorine is introduced into the environment. As a result, fluorine mass balance during coal combustion is required to meet emission regulations.

The Standard Reference Materials Program announces the addition of certified fluorine values to those trace elements previously certified in powdered coal SRMs 1632b and 1635. All measurements for the additional certifications were carried out through round robins conducted by ASTM Committee D 05 on coal and coke, in conjunction with efforts to validate ASTM Method D 3761, and to compare results obtained by that method with those obtained by alternative methods in common use for fluorine analyses. Fluorine is certified in SRM 1632b at (41.7×3.8) mg/kg and in SRM 1635 at(25.9×3.3) mg/kg.

SRM 656—SILICON NITRIDE POWDERS FOR QUANTITATIVE ANALYSIS BY POWDER DIFFRACTION

Ubiquitous to the processing of silicon nitride is the transformation of the low-temperature phase to the high-temperature β phase. A typical powder designed for manufacture of dense silicon nitride products will consist of approximately 90 % α phase, with the remainder being β phase and amorphous material. Upon sintering, the α phase transforms into the β, and an interlocking microstructure of β grains is the desired result. Thus, the quantitative characterization of the α to β ratio and the amorphous content are critical to the quality control of silicon nitride processing.

Conventional techniques of analyzing x-ray powder diffraction data for a quantitative analysis are based on the reference intensity ratio (RIR) method. Its application to the quantification of the α and β phases of silicon nitride is complicated by the unavailability of pure end members and the complete overlap of the x-ray pattern of the α phase with that of the β. Quantitative Rietveld analysis (QRA), a more recent technique, is by its very nature free of these difficulties and its increased accuracy renders it capable of addressing the question of amorphous phase content. The QRA method was used to certify SRM 656, which can in turn, be used in conjunction with the RIR method for quantitative analysis of silicon nitride.

SRM 656 consists of two powders intended for quantitative analysis of the α and β polymorphs of silicon nitride via powder diffraction methods. Both powders are combinations of the α and β polymorphs; one is high in α content, the other is high in β content. The powders are fine grained and equiaxed, and are bottled under argon to protect against atmospheric moisture. The certified values for these powders include the α, β, and amorphous phase content, the RIR, and 11 relative

intensities. The α, β, and amorphous phase content were determined using QRA analysis of neutron time-of-flight powder diffraction data. The homogeneity of the SRM material was verified with a QRA analysis of x-ray powder diffraction (XRD) data. The RIR and relative intensity values were determined from the profile fitting of additional XRD data. Data on lattice parameters and particle size distribution by laser scattering are included for information.

NIST ISSUES RADIOPHARMACEUTICAL SRM FOR HEALTH CARE PROVIDERS

Radioactive ^{89}Sr as strontium chloride has been approved by the U.S. Food and Drug Administration for use in pain relief for terminal cancer patients. In both breast and prostate cancer, the disease metastasizes to the bone, resulting in severe pain. The beta particles emitted in the decay of the 50 d half life ^{89}Sr provide an alternative palliative agent to the use of narcotics such as morphine. The physicians would like to assay the radiopharmaceutical prior to injection, but the commercial product has an impurity radionuclide, ^{85}Sr, which confounds the measurement in the commercially available radionuclide calibrators.

Scientists at NIST have produced, in collaboration with research associates from the Nuclear Energy Institute, a Standard Reference Material (SRM) for ^{89}Sr, and, in a separate Cooperative Research and Development Agreement with a private company have calibrated a new instrument for measuring the pharmaceutical for use in clinics and radiopharmacies.

The ^{89}Sr used in SRM 4426A was produced in a fast-flux nuclear reactor in Obinsk, Russia, and purified at NIST. The material was standardized by high-accuracy liquid-scintillation counting, and decay-scheme data were established by Ge(Li) gamma-ray spectrometry. The high-activity SRM 4426H-A was then distributed to the FDA's calibration laboratory and to North American radiopharmaceutical manufacturers; a lower-activity SRM 4426L-A was distributed mainly to instrument companies and medical centers. Pure samples of ^{89}Sr, and of the impurity nuclide ^{85}Sr, were used at the private company to establish calibration factors for the commercial radionuclide calibrators. This SRM and the new instrument will allow U.S. clinics to accurately assay this palliative agent, which could be used for up to 100 000 patients annually in the United States alone.

NIST SETS STANDARD FOR DOMESTIC SLUDGE

Scientists at NIST have developed some unusual Standard Reference Materials over the years. The NIST SRM Catalog includes standards for whale blubber, pine needles, egg powder and peach leaves. Now joining this eclectic collection is an SRM for domestic sludge. Environmental laboratories can use the new sludge SRM as a means of assessing the accuracy of instruments and methods for analyzing hazardous elements in sludge. Domestic sludge, once dehydrated, can be sold as fertilizer for food crops, lawns and flower beds. Environmental protection agencies set limits on the concentration of heavy metals in sludge used as fertilizer since they may be taken up in the edible portion of the crop. One unit of the SRM includes 40 g of dried, pulverized and sterilized sludge as well as certified concentration values for nine regulated metals and other elements in the sludge. NIST obtained the material for SRM 2781 from the Metropolitan Denver Sewage Disposal District No. 1 through a contract with the U.S. Geological Survey. It is available for $227 from the NIST SRM Program, 204 Engineering Mechanics Building, Gaithersburg, MD 20899-0001, (301) 975-6776, fax: (301) 975-3730.

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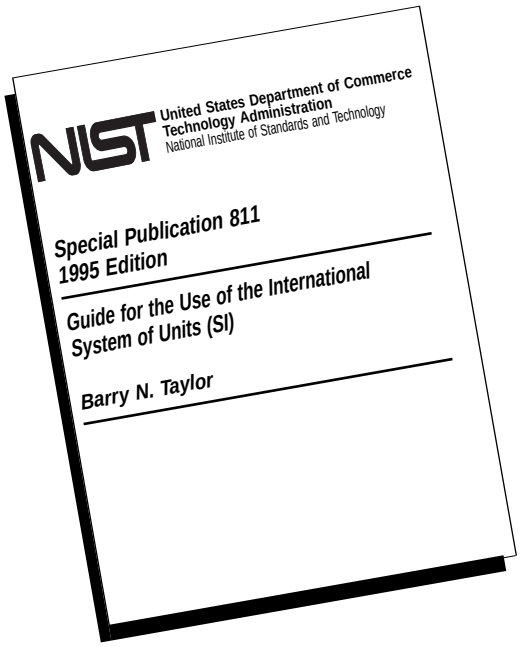

Uncertain about the International System of Units (universally abbreviated SI), the modern metric system used throughout the world? Do you need to know the proper way to express the results of measurements and the values of quantities in units of the SI? Do you need to know the NIST policy on the use of the SI? Then you need the 1995 edition of the National Institute of Standards and Technology Special Publication 811, *Guide for the Use of the International System of Units (SI)*.

The 1995 edition of the National Institute of Standards and Technology Special Publication 811, *Guide for the Use of the International System of Units (SI)*, by Barry N. Taylor, is now available.

The 1995 edition of SP 811 corrects a number of misprints in the 1991 edition, incorporates a significant amount of additional material intended to answer frequently asked questions concerning the SI and SI usage, and updates the bibliography. The added material includes a check list for reviewing the consistency of written documents with the SI. Some changes in format have also been made in an attempt to improve the ease of use of SP 811.

The topics covered by SP 811 include:

- NIST policy on the use of the SI in NIST publications.
- Classes of SI units, those SI derived units that have special names and symbols, and the SI prefixes that are used to form decimal multiples and submultiples of SI units.
- Those units outside the SI that may be used with the SI and those that may not.
- Rules and style conventions for printing and using quantity symbols, unit symbols, and prefix symbols, and for spelling unit names.
- Rules and style conventions for expressing the results of measurements and the values of quantities.
- Definitions of the SI base units.
- Conversion factors for converting values of quantities expressed in units that are mainly unacceptable for use with the SI to values expressed mainly in units of the SI.
- Rounding numbers and rounding converted numerical values of quantities.

Single copies of the 84-page SP 811 may be obtained from the NIST Calibration Program, Building 820, Room 232, Gaithersburg, MD 20899-0001, telephone: 301-975-2002, fax: 301-948-3825.

NIST Technical Publications

Periodical

Journal of Research of the National Institute of Standards and Technology—Reports NIST research and development in those disciplines of the physical and engineering sciences in which the Institute is active. These include physics, chemistry, engineering, mathematics, and computer sciences. Papers cover a broad range of subjects, with major emphasis on measurement methodology and the basic technology underlying standardization. Also included from time to time are survey articles on topics closely related to the Institute's technical and scientific programs. Issued six times a year.

Nonperiodicals

Monographs—Major contributions to the technical literature on various subjects related to the Institute's scientific and technical activities.

Handbooks—Recommended codes of engineering and industrial practice (including safety codes) developed in cooperation with interested industries, professional organizations, and regulatory bodies.

Special Publications—Include proceedings of conferences sponsored by NIST, NIST annual reports, and other special publications appropriate to this grouping such as wall charts, pocket cards, and bibliographies.

National Standard Reference Data Series—Provides quantitative data on the physical and chemical properties of materials, compiled from the world's literature and critically evaluated. Developed under a worldwide program coordinated by NIST under the authority of the National Standard Data Act (Public Law 90-396). NOTE: The Journal of Physical and Chemical Reference Data (JPCRD) is published bimonthly for NIST by the American Chemical Society (ACS) and the American Institute of Physics (AIP). Subscriptions, reprints, and supplements are available from ACS, 1155 Sixteenth St., NW, Washington, DC 20056.

Building Science Series—Disseminates technical information developed at the Institute on building materials, components, systems, and whole structures. The series presents research results, test methods, and performance criteria related to the structural and environmental functions and the durability and safety characteristics of building elements and systems.

Technical Notes—Studies or reports which are complete in themselves but restrictive in their treatment of a subject. Analogous to monographs but not so comprehensive in scope or definitive in treatment of the subject area. Often serve as a vehicle for final reports of work performed at NIST under the sponsorship of other government agencies.

Voluntary Product Standards—Developed under procedures published by the Department of Commerce in Part 10, Title 15, of the Code of Federal Regulations. The standards establish nationally recognized requirements for products, and provide all concerned interests with a basis for common understanding of the characteristics of the products. NIST administers this program in support of the efforts of private-sector standardizing organizations.

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Federal Information Processing Standards Publications (FIPS PUB)—Publications in this series collectively constitute the Federal Information Processing Standards Register. The Register serves as the official source of information in the Federal Government regarding standards issued by NIST pursuant to the Federal Property and Administrative Services Act of 1949 as amended, Public Law 89-306 (79 Stat. 1127), and as implemented by Executive Order 11717 (38 FR 12315, dated May 11, 1973) and Part 6 of Title 15 CFR (Code of Federal Regulations).

NIST Interagency Reports (NISTIR)—A special series of interim or final reports on work performed by NIST for outside sponsors (both government and nongovernment). In general, initial distribution is handled by the sponsor; public distribution is by the National Technical Information Service, Springfield, VA 22161, in paper copy or microfiche form.

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