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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, Administration Building, A635, Gaithersburg, MD 20899; telephone: 301/975-3572.

REPORT RECAPS BALDRIGE AWARD'S FIRST 3 YEARS

"... Interest in the award and in quality management is growing faster than any of us had imagined. The award is quickly becoming the most coveted prize in U.S. industry and symbolizes a renewed resurgence in quality," says Commerce Secretary Robert A. Mosbacher in Interim Report to the President and to the Congress on the Malcolm Baldrige National Quality Award. The report summarizes the award program's first 3 years and discusses the possibility of expanding award categories as well as the use of advertising by winners. The award program is managed by NIST with active involvement by the private sector. Copies are available from the National Technical Information Service, Springfield, VA 22161. Order by PB #91-167833 for $23 prepaid.

FASTENER ADVISORY COMMITTEE APPOINTED

A 15-member committee has been appointed to advise NIST and the secretary of commerce on accreditation of laboratories that test certain nuts, bolts, and other fasteners. The Fastener Advisory Committee is mandated by the Fastener Quality Act of 1990, which requires the secretary to establish a program to accredit or recognize laboratories to test fasteners. The purpose is to protect public health and safety by ensuring that critical fasteners conform to specifications. The statute sets civil and criminal penalties for failure to comply with its provisions. The program will be set up under the already existing National Voluntary Laboratory Accreditation Program.

FIRST LABS ACCREDITED FOR POSIX CONFORMANCE TESTING

The first laboratories to be accredited under the National Voluntary Laboratory Accreditation Program (NVLAP) to test computer operating system interfaces for conformance with the standard for Portable Operating System Interface for Computer Environments (POSIX) were announced by NIST. Compliance with the POSIX standard provides greater assurance that a computer program written for one machine will work on another. Under the NVLAP program, administered by NIST, the laboratories are accredited in the field of computer applications testing to use NIST POSIX Conformance Test Suite (NIST-PCTS: 151-1). The suite is used to test computer operating system interfaces for compliance with the POSIX standard, which has been issued as Federal Information Processing Standard (FIPS) 151-1. For information on NVLAP, contact Jeffrey Horlick, A124 Building 411, NIST, Gaithersburg, MD 20899, 301/975-4020, fax: 301/975-3839. For information on the POSIX validation program, contact James A. Hall, B266 Technology Building, NIST, Gaithersburg, MD 20899, 301/975-3273, fax: 301/590-0932.

THE CREEP OF COPPER STUDIED

Copper is used extensively as a stabilizing material for superconducting magnets and as a conductor in high-field, cryogenic magnets. Operating such magnets puts the conductor under intense pressure for extended periods of time. To assure reliable performance, users need to know the dimensional stability of the conductor. NIST researchers have made creep measurements at 295, 76, and 4 K of 99.9 percent pure, oxygen-free copper. Paper No. 9-91 describes the NIST study. Available from Jo Emery, Div. 104, NIST, Boulder, CO 80303, 303/497-3237.

NIST SIGNS AGREEMENT FOR FIPS BASIC TEST SUITE

NIST has signed a Cooperative Research and Development Agreement (CRADA) to develop a test suite for FIPS 68-2, BASIC programming language. The agreement with private industry marks the first time that a CRADA has been used to obtain the needed tests for federal programming language standards. The result of this cooperative effort will be an automated system for testing BASIC language processors for conformance to FIPS 68-2 BASIC. Under the terms of the CRADA, NIST will provide the administrative and scientific direction, while private industry will develop and maintain the test suite. The private company will own and market the resulting BASIC test suite. NIST will receive a nonexclusive, paid-up license to use the suite for testing BASIC implementations for conformance to FIPS 68-2, BASIC. For technical details, contact L. Arnold Johnson, A266 Technology Building, NIST, Gaithersburg, MD 20899, 301/975-3247.

VIDEO HIGHLIGHTS 1990 WINNERS OF BALDRIGE AWARD

To help companies better understand the Malcolm Baldrige National Quality Award and what it takes to improve quality, a new five-part, 35 minute video features the four 1990 winners. They are: Cadillac Motor Car Division and IBM Rochester (manufacturing category), Federal Express Corp. (service category), and Wallace Co. Inc. (small business category). The award, named for the late secretary of commerce, was established by legislation in August 1987. It promotes national awareness about the importance of improving quality management and recognizes quality achievements of U.S. companies—although the award is not for specific products or services. So far, nine U.S. companies have won the award. For 1991, 106 are in the running. The award program is managed by NIST with active involvement of the private sector, including the American Society for Quality Control (ASQC). The video is available from ASQC for $15, including shipping and handling. Item T992 in ASQC's inventory, it can be ordered by calling 1-800/248-1946.

NEW APPARATUS TO AID IN AEROSPACE VEHICLE DESIGN

Designers of future high-speed aircraft and aerospace vehicles have some formidable challenges, not the least of which are thermal insulation systems. These vehicles will be propelled by supercold (cryogenic) fuels; they also will generate tremendous heat as they hurtle through the atmosphere at 20 times the speed of sound. Thermal insulation systems will have to work in both extreme temperature ranges—as well as meet weight and volume restrictions. NIST scientists have developed an apparatus that can test insulation systems under conditions similar to actual use and more accurately predict in-use performance. The apparatus can measure thermal conductivity across enormous temperature differences—from 27 to 1,100 K. It is also built to withstand tremendous mechanical loads and gas pressures. Paper No. 15-91 describes the apparatus. Available from Jo Emery, Division 104, NIST, Boulder, CO 80303, 303/497-3237.

ENERGY-EFFICIENT LIGHTING TESTS PROPOSED

Technical experts, manufacturers, and others concerned with the performance of lighting equipment are asked to comment on proposed test methods and standards for a new program to accredit laboratories to test the energy efficiency of electric lighting products. The program was recently established by NIST under the National Voluntary Laboratory Accreditation Program at the request of the National Electrical Manufacturers Association. Laboratories will be accredited to test such products as indoor and outdoor luminaries, lamps, ballasts, and systems using test methods and performance criteria developed by standards-making organizations. For a copy of the proposed test methods and standards, contact Lawrence S. Galowin, A124 Building 411, NIST, Gaithersburg, MD 20899, 301/975-4022, fax: 301/975-3839.

INFORMATION SYSTEMS DICTIONARY ADOPTED AS FIPS

The American National Dictionary for Information Systems (ANSI X3.172-1990) has been adopted as a FIPS (Federal Information Processing Standard) Guideline. The dictionary consists of an alphabetic listing of terms and their definitions. The FIPS provides a reference within the Federal government for terms and definitions used in such fields of information systems as computers, data communications, and data processing. The publication is available from the National Technical Information Service, Springfield, VA 22161. Order by FIPSPUB11-3 for $45 prepaid.

NEW FACILITY TO SUPPORT SIGNAL-PROCESSING RESEARCH

A new research facility at NIST is built around a "video supercomputer" to study signal-processing techniques needed for future high-performance computer displays and video-imaging systems. Featuring a "Princeton Engine" video computer created by the David Sarnoff Research Center in Princeton, NJ, the facility is funded in part by the Defense Advanced Research Projects Agency. "The computer is an extremely useful adjunct to our existing research programs, which address the mathematics of signal processing and the testing and evaluation of electronic circuitry," said institute Director John W. Lyons in recent congressional testimony. "This facility will be used both for defense-related research and to support NIST's programs. It should save researchers both time and money and help move products to the defense and commercial markets more quickly."

ELECTRIC FIELDS MAY HELP UNLOCK MEMBRANE FUNCTIONS

Proteins embedded within the fluid membranes of our cells sense the tug of surrounding electric fields and respond differently to various frequencies. Now, researchers are becoming aware of possible effects that such fields could have on the assorted functions of membrane proteins. NIST scientists have formulated a theory for electroconformational coupling, which is a fundamental process of cellular energy and signal conversion. The theory offers a possible explanation of how membranes use energy from electric fields to perform certain functions. For example, a protein, by changing back and forth through different shapes that are differentially sensitive to an electric field, can use energy from that field to drive chemical reactions away from equilibrium.

SETTING COMPUTER CLOCKS IN A NETWORK ENVIRONMENT

NIST is developing methods for synchronizing the clocks of networked computers and setting them accurately to standard time. This will benefit companies in industries such as banking, transportation and manufacturing, which connect computers together to share data and conduct operations. Most computers have internal clocks, which need to be synchronized throughout the network to time stamp important data and prevent operational problems. The NIST service would synchronize the server computer (which controls the network and provides centralized services to client computers) to a NIST time source by telephone, radio signal, or through a higher-level network. Client computers would then be synchronized to that server. Accuracy for a packet-switched system might be ± 10 ms, depending on configuration. This type of synchronization might be provided through a wide-area network if there is sufficient user interest and support. Contact Judah Levine, Div. 847.10, NIST, Boulder, CO 80303, 303/497-3903, e-mail: judah@india.colorado.edu.

INTRODUCTION TO U.S. LAB ACCREDITATION PUBLISHED

Laboratory Accreditation in the United States (NISTIR 4576) is designed for users who may not be familiar with this important conformity assessment activity. The report is a sequel to ABC's of Standards-Related Activities in the United States and ABC's of Certification Activities in the United States. Information is provided so users may make informed decisions on the selection and use of accredited laboratories and accreditation programs. To order, send a self-addressed mailing label to Standards Code and Information Program, A633 Administration Building, NIST, Gaithersburg, MD 20899, 301/975-4031.

GATT STANDARDS ACTIVITIES REPORTED FOR 1990

During 1990, NIST Standards Code and Information (SCI) program staff responded to more than 400 requests for information on proposed foreign regulations from the Secretariat of the General Agreement on Tariffs and Trade (GATT) in Geneva. Regulations on telecommunications equipment, chemicals, ozone layer depleting substances, metric use, medical products, and electrical equipment were most often requested. GATT Standards Code Activities of the National Institute of Standards and Technology 1990 (NISTIR 4559) describes NIST's role in support of the GATT Agreement on Technical Barriers to Trade (Standards Code), which includes operating the U.S. inquiry point for information on standards and certification activities that might affect U.S. trade. SCI also coordinates comments on foreign regulations, arranges for translations of texts, and maintains the GATT hotline (301/975-4041, not toll free). To order, send a self-addressed mailing label to SCI, A163 Building 411, NIST, Gaithersburg, MD 20899, 301/975-4037.

"SUPERCHAMBER" TO EVALUATE EM COMPATIBILITY

NIST is pioneering a new concept in test chambers for evaluating the electromagnetic (EM) compatibility of a wide range of electronic products. Such chambers are used to measure the immunity of systems and devices to electromagnetic fields by exposing them to known fields in the chamber and to measure the EM energy radiated from systems and devices. The new chamber combines the features of two systems commonly used for this type of testing—a transverse electromagnetic (TEM) cell and a reverberating chamber. This combination provides a test capability over the frequency range 10 kHz to 40 GHz, far exceeding capabilities of any other EM test facility. The method also will provide great cost savings in performing these critical measurements. NIST has developed the first combined chamber for the U.S. Army; it measures $1.3 \times 2.4 \times 3.9$ m. While this chamber will be used for testing Army electronic equipment, the concept has direct application to commercial products. Much larger chambers may be possible where automobiles, helicopters, aircraft, or other large systems could be tested. Measurement and Evaluation of a TEM/Reverberating Chamber (TN1342) summarizes results. Available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402. Order by stock no. 003-003-030355-4 for $5.50 prepaid.

HEAT SHOCK PROTEINS HELP MAKE NEW DNA

When the temperature rises, heat shock proteins go to work to keep normal cellular proteins from collapsing under the stress, research over the past decade has shown. Now scientists have discovered a new role taken on by one family of heat shock proteins in non-stress conditions. They perform an essential role in DNA replication, the way living things create new copies of genetic information. Even more surprising is the mechanism the heat shock proteins use in their new role, says a NIST research chemist at the Center for Advanced Research in Biotechnology (CARB). They split an otherwise inactive protein into two identical subunits, which are now active and able to bind to DNA. The NIST scientist collaborated with University of Maryland and National Cancer Institute scientists on this work described earlier this year in Nature. CARB was established in 1984 by NIST, the University of Maryland, and Montgomery County, MD, as a unique center for government, academic, and industry scientists.

BIOLOGICAL DATABASE MERGED TO ROBOTIC SOFTWARE

A new commercially available robotic system for protein crystallization experiments now includes the recipes for protein crystals of more than 600 biological macromolecules. The crystallization database and robotic system were joined through a Cooperative Research and Development Agreement between the Center for Advanced Research in Biotechnology (CARB) and private industry. The system will help scientists studying crystallization of proteins or other biological macromolecules. "This is particularly useful to assist in drug design, protein engineering, protein folding, or protein stability studies," the NIST scientist said. He and colleagues at CARB developed the NIST/CARB Biological Macromolecule Crystallization Database in 1988. After signing the agreement in January 1991, the CARB team integrated the database into the robotic system's memory. CARB was established in 1984 by NIST, the University of Maryland and Montgomery County, MD, as a unique center for government, academic, and industry scientists.

METHOD PINPOINTS TOXIC INSULATOR BYPRODUCT

For the first time, NIST researchers have measured a previously undetected toxic material—disulfur decafluoride (S_2F_{10})—produced when a common gas used for insulating electrical power equipment degrades. NIST has created a swift, sensitive method for gauging S_2F_{10} at environmentally important trace (parts per billion) levels. The method employs an instrument found in most analytical chemistry labs—a gas chromatograph/mass spectrometer, outfitted with modifications. An analysis takes about 5 min. Toxic S_2F_{10} develops when the non-toxic compressed insulating gas sulfur hexafluoride (SF_6) decomposes chemically in the electrical discharges typical in transformers and other power components. NIST tests show the toxic gas is produced under conditions like those found at power stations and substations. Whether S_2F_{10} presence poses a hazard to utility workers working around SF_6 remains undetermined. Scientists say more research is needed to learn what happens to S_2F_{10} once it is formed. NIST intends to participate in a planned government/industry consortium that aims to measure SF_6 byproducts at utility sites.

SPACE-GROWN CRYSTALS SURPRISE RESEARCHERS

A researcher with NIST has grown zeolites—inorganic crystals with many commercial applications—in the zero-gravity environment of space for the first time. The experiment was performed to see what effect gravitation has on the crystal growth of this class of technologically important materials. In collaboration with private industry the NIST researcher grew the porous crystals in an experiment aboard the Atlantis space shuttle flight April 5-11, 1991. While assuming the crystals grown in space would be shaped like a cube, as those that are grown on the Earth, the NIST scientist discovered something unexpected: They in fact were rod shaped. Zeolites are a class of minerals composed mainly of silicon, aluminum, oxygen, cations, and water. They are full of extremely tiny holes, 3 to 10 Å in size—about the size of a very small molecule—making them attractive commercially, such as in the catalytic cracking of petroleum.

FIRE HAZARDS OF WIRES AND CABLES UNDER STUDY

Thousands of miles of wires and cables snake through the walls of our offices and homes making possible such conveniences as electricity and communications. But are these products also a hidden threat during a fire? Researchers at NIST are working with the National Electrical Manufacturers Association (NEMA) to get a better picture of the behavior of these products during a fire. The researchers will be using a NIST-developed computer model to simulate how the product would burn, how much smoke would be produced, and how the smoke would move through a building. In addition, and perhaps most importantly, the model can keep track of how much toxic smoke these materials produce relative to the smoke produced by other combustible items involved in the fire. NEMA hopes this project will result in more realistic test methods.

NIST/U.S.S.R. ACADEMY RENEW SCIENCE AGREEMENT

The renewal of a Memorandum of Understanding between NIST and the U.S.S.R. Academy of Sciences on Cooperation in the Physical, Chemical, and Engineering Sciences was signed May 13, 1991, during the Second Joint Commission Meeting of the U.S./U.S.S.R. Basic Sciences Agreement in Moscow. The memorandum outlines scientific cooperation that may be conducted in theoretical and experimental physics, chemistry, and the basic scientific aspects of engineering. Topics of cooperation will be selected by both parties to cover areas of mutual interest in which both sides have active work in progress. NIST also has agreements for similar scientific cooperation with Japan, France, China, and South Korea.

PUBLIC-KEY CRYPTOGRAPHY REVIEWED

A new report, Public-Key Cryptography (NIST SP 800-2), presents a state-of-the-art survey of public-key cryptography from 1988–1990. (Cryptography covers the transformation of ordinary text into coded form and vice versa; the goal is security for transmissions over insecure channels.) This report compares public-key to conventional (secret-key) cryptography, surveys the major existing public-key systems, and examines criteria for systems and protocols for use. The information will be useful to systems implementors. The frameworks developed are versatile enough for a variety of systems, such as electronic mail and electronic fund transfer. Available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402. Order by 003-003-03078-3 for $9 prepaid.

FEDERAL ROLE IN CONFORMITY ASSESSMENTS SUGGESTED

Private-sector panelists from two NIST/industry workshops—on pressure vessels and electromagnetic compatibility—made several common recommendations to assist in conformity assessment activities to gain acceptance of U.S. products in international markets such as the European Community (EC). The recommendations: the U.S. government should assume an active role in representing their respective industries in negotiations with the EC with the goal of designating notified bodies within the United States; the U.S. government should sponsor advisory committees to deal with issues of interest specific to their sectors; and NIST should assume a proactive role in disseminating information about draft regional and international standards concerning their sectors. Conformity Assessment Workshop on Pressure Vessels (NISTIR 4542) and Conformity Assessment Workshop on Electromagnetic Compatibility (NISTIR 4611) are available prepaid for $26 each, including handling, from the National Technical Information Service, Springfield, VA 22161. Order NISTIR 4542 by PB #91-192997 and NISTIR 4611 by PB #91-192989.

ARCTIC POLLUTION: NEW WAYS TO TRACK ITS EFFECTS

Studies of contaminant levels in marine mammal tissues give scientists a picture of how pollution affects the marine ecosystem over time. Now a new publication on tissue collection procedures should help marine biologists refine their studies. The 33-page document describes how marine mammal tissues are collected for long-term storage as part of the Alaska Marine Mammal Tissue Archival Project (AMMTAP) at the National Biomonitoring Specimen Bank at NIST's Gaithersburg, MD laboratory. These procedures can be applied to other marine mammal research projects. NIST, the National Oceanic and Atmospheric Administration, and the Minerals Management Service for the Interior Department started the AMMTAP project in 1987 with the goal of documenting long-term trends in environmental quality. Alaska Marine Mammal Tissue Archival Project: Revised Collection Protocol is available from the National Technical Information Service, Springfield, VA 22161. Order by PB #91-184796/AS for $15 prepaid.

CONSORTIUM TO HELP U.S. METAL POWDERS INDUSTRY

Three manufacturers that produce or use metal powders and an office of the Department of Energy that is concerned with the energy efficiency of industrial processes are joining NIST in a project to improve the competitiveness of the U.S. metal powders industry. The focus will be on the intelligent processing (IPM) of rapidly solidified metal powders by high-pressure, inert gas atomization. The program is open to researchers from industry and government who are concerned about quality in the production of rapidly solidified metal powders and IPM technology. For information, contact Dr. John P. Gudas, Deputy Chief, Office of Intelligent Processing of Materials, B344 Materials Building, NIST, Gaithersburg, MD 20899, 301/975-5727.

SUCCESSFUL PROGRAM TESTS THE TESTERS

In 1989 NIST took over the world's first program for certifying impact-testing machines from the U.S. Army. Since then, the program—termed Charpy V-notch testing—has been streamlined substantially. The program is important because manufacturers of military hardware, for instance, need to know the impact resistance of the sides of a tank. NIST researchers have developed a computer software program that has increased efficiency by 40 percent, allowing NIST staff the time to respond more rapidly to individual customer inquiries and problems. Customers generally receive their results within 2 weeks of submitting the data. Since the NIST program is recognized worldwide, 30 percent of the certification requests come from other countries. More than 1,000 Charpy V-notch testing machines are certified annually. For information, contact Dominique Shepherd, Div. 853, NIST, Boulder, CO 80303, 303/497-3211.

REPORT ON JAPANESE BUILDING TECHNOLOGY

The Japanese government and institutions such as banks are working hard to put the country at the forefront of intelligent building technology, says a NIST researcher who visited Japan to assess the state-of-the-art there in intelligent buildings. He found the Japanese quickly install new systems and products into buildings. Among the technologies used are earthquake and sway monitoring systems; infrared sensors to regulate HVAC, lighting, and Venetian blinds; fiber-optic systems to send sunlight to windowless offices; and robots for cleaning and inspecting for structural damage. A major problem shared by both the United States and Japan is a lack of standards for hardware and software that makes it difficult to integrate equipment from different manufacturers and, in some cases, equipment from the same manufacturer. Intelligent Building Technology in Japan (NISTIR 4546) is available by sending a self-addressed mailing label to Arthur Rubin, A313 Building Research Building, NIST, Gaithersburg, Md. 20899.

U.S.–U.S.S.R. STANDARDS WORKING GROUP

Under the auspices of the Joint U.S.-U.S.S.R. Commercial Commission, a Standards Working Group (SWG) was established and recently held its first meeting in Washington, DC. The chairman of Gosstandart, led the Soviet delegation that met with representatives of NIST, other federal agencies, and the U.S. private sector. The major aim of the SWG is to explore mutually advantageous avenues of cooperation, including promotion of international standards and product acceptance criteria. At the first session, emphasis was placed on exchange of information about standards and conformity assessment practices in the two countries. The second meeting of the group will be hosted by the Soviets this fall.

CAD/CAM DEMONSTRATION FACILITY IS ON-LINE

The Northeast Manufacturing Technology Center (NEMTC) located in Troy, NY, at the Rensselaer Polytechnic Institute, has established a CAD/CAM demonstration facility designed to assist small manufacturing firms in their quest for automating their manufacturing facilities. NEMTC is one of the five NIST Manufacturing Technology Centers currently in operation throughout the United States.

The staff at the demonstration facility at NEMTC has compiled a large database of CAD/CAM software products and has set up a variety of computer workstations that can be used by small firms to gain hands-on experience with different CAD/CAM packages before any purchase is actually made. The demonstration facility currently has over 40 software packages on-line, and the database is growing at the rate of one to two new packages per week. In the current mode of operations, the NEMTC staff consults with personnel from the small firms and then recommends several software packages on a case-by-case basis. The firms' staff can then experiment with the most appropriate software packages for 1 or 2 days before the final choice is made.

WORKSHOP INTRODUCES INDUSTRY TO NIST TESTING STRATEGIES FOR ANALOG AND MIXED-SIGNAL PRODUCTS

NIST recently held a 3 day workshop to introduce representatives from industry to the NIST strategy, methodology, and analytical tools for developing and implementing efficient tests for analog and mixed-signal devices and instruments. Testing is expensive; many of these products are sufficiently complex or have so many operating states that it is not physically or economically feasible to perform exhaustive testing. NIST has responded to the need for reliable cost-effective testing by developing methods for identifying a reduced set of test points that effectively yields the same information as if comprehensive testing had been carried out and in some cases, improves the prediction of performance. The reductions are significant; in one example of a 13 bit analog-to-digital data converter the reduction factor is 16. Eleven companies sent representatives to learn about NIST procedures such as determining the linearity of data converters, the frequency response of amplifier/attenuator networks, the time response of filters, and the measurement errors of a multirange ac voltmeter.

NIST SCIENTISTS RESOLVE FUEL DENSITY DISCREPANCY

NIST scientists recently resolved a controversy involving jet fuel density measurements as performed in the aircraft industry. A commercial avionic liquid density transducer had been used for monitoring the quantity of fuel carried on a commercial intercontinental aircraft with a quoted accuracy of ± 0.4 percent. This device is provided by the manufacturer of a fuel monitoring system for large sectors of the aircraft industry. The NIST scientists designed a special density testing program where a hydrocarbon liquid of unknown density was used as a benchmark; the density of this liquid could be determined by NIST with an accuracy of better than ± 0.1 percent. The NIST-prepared testing program was developed and presented to representatives from several interested firms. The comparison testing was performed with several density measurement devices used by the interested parties concurrently with three different instruments used by NIST. A total of 22 measurements of density were performed over 5 days of testing and over a temperature range of 10 to 35 °C. The overall accuracy of the NIST system, which was substantiated at ± 0.06 percent, resolved the controversy to the satisfaction of all the test participants. The resulting improvements in measurement uncertainty can change the carrying capacity of a single fully loaded aircraft by more than 500 kg.

X-RAY DETECTOR INCORPORATES DIFFRACTION

NIST has received a patent on a new type of x-ray detector, which combines the functions of diffraction with detection.

The device consists of a large single crystal of semiconductor, which is doped with a photovoltaic detector at a precise depth beneath the surface. Changes in the depth distribution and quantity of radiation occur at the Bragg condition at which diffraction takes place. The photovoltaic detector perceives these changes, and the resulting electrical current indicates the absence or presence of the Bragg condition.

Applications of the new detector are likely to involve stabilizing the monochromatic high-energy x-ray radiation which is produced in synchrotron light sources for angiography and diffraction from biochemical molecules. The device is presently being tested as an x-ray energy standard at the synchrotron light source HASYLAB in Hamburg, Germany, for use on all of the x-ray beamlines there.

INFRARED CHARACTERIZATION OF AN OPEN-SHELL FREE-RADICAL COMPLEX

An understanding of the phenomenon of bonding is of fundamental importance in chemistry, and it has proven convenient over the years to classify bonds as covalent, ionic, hydrogen, van der Waals, etc., depending on the nature of the bond in question.

NIST scientists reported on the first infrared study of the class of bonding that takes place between one closed-shell partner (containing an even number of electrons, all of which are paired) and one open-shell partner (containing an odd number of electrons, so that complete pairing is impossible). Since traditional ideas of the chemical bond are based on the concept of electron pairs, it was speculated that a completely new type of bonding might arise when full pairing was impossible. The present work, however, suggests strongly that rather conventional ideas taken from the literature on van der Waals bonding will suffice to explain most of the essential features of the bond between the closed-shell HF partner and the open-shell NO partner.

The study involved both theoretical and experimental contributions at NIST. The NO-HF complex was formed in a supersonic jet, and an infrared spectrum was recorded using a newly constructed molecular-beam optothermal spectrometer with a color-center-laser excitation source and a liquid-helium-cooled bolometer detector. The spectral data on NO-HF could not be understood by conventional methods but were successfully treated using a computer program containing new interaction terms specifically developed to take into account most of the important vector-coupling effects associated with the unpaired electron.

WEAR TRANSITION DIAGRAMS FOR ADVANCED CERAMICS

Advanced structural ceramics are used in diverse applications requiring resistance to abrasion and erosion, resistance to corrosive wear, wear resistance at elevated temperatures, low density, and unique electrical, thermal, and magnetic properties. Limited knowledge in the tribological performance is one of the major technical barriers that must be overcome before the full potential of ceramics in tribological applications is realized. The tribology program at NIST has addressed this issue by compiling data and mechanistic information assembled in simple diagrams, which show the range of wear rates and friction coefficients as a function of load, temperature, and speed. These "wear transition diagrams" and "wear maps" are useful for design and material selection for tribological applications. These diagrams and the models that are being developed can be utilized to suggest guidelines for the control of the coefficient of friction and the reduction of the rate of wear in advanced ceramics.

INDUSTRIAL WORKSHOP ON SMALL ANGLE X-RAY SCATTERING

NIST recently hosted a workshop for users of the NIST 10 m small angle x-ray scattering (SAXs) facility. Representatives from 10 industrial organizations joined NIST staff members in this workshop. The session featured speakers from industry, academia, and NIST who presented research accomplished using this facility. Also discussed were technical issues that confront the users and operators of the facility. This information will be used in planning future improvements to the facility. The 10 m SAXS camera, in operation for nearly 4 years, has been used by a variety of academic, industrial, and government workers to study microstructure in polymeric materials and biological systems. The facility is available for proprietary as well as collaborative research.

INTERCOMPARISON STUDY OF ROCKWELL HARDNESS TEST BLOCKS

An intercomparison study of Rockwell hardness test blocks marketed in the United States has been completed by NIST in collaboration with ASTM. Three hardness levels for each of four of the most commonly used Rockwell scales—namely C, B, 30N and 30T—were considered. Hardness measurements were made on commercial hardness testers. For each series of tests comparing similar blocks, all measurements were made on one machine, all measurements were made by one person, and all measurements were made with the same indenter and supporting anvil.

Under these nearly ideal test conditions, it was found that there are some significant differences among hardness test blocks of different manufacturers. These differences demonstrate the need for national hardness standards in the United States. NIST has committed to develop some of these standards.

In addition to the differences among blocks of different manufacturers, the measurement results in a number of cases do not satisfy ASTM requirements for test block uniformity. Re-evaluation of

brass test blocks after several years indicates significant instability over time for some of them, which suggests the need to develop test block material with improved stability as well as more consistent uniformity.

NEW CARBON MOLECULE STUDIED WITH NEUTRONS

The vibrational spectrum of a remarkable new molecule, carbon-60, has been measured using a neutron scattering technique at the NIST research reactor. Often referred to as "buckminsterfullerene" or "buckyballs" because of their unusual geodesic-sphere structure, C_{60} molecules constitute, when solidified and purified, a new kind of solid carbon very different from the well-known forms, diamond and graphite. Each molecule is a 60-atom spherical hollow framework, which closely resembles the seaming on a soccerball.

In a collaboration involving scientists from NIST, Ohio University, and Penn State University, the energy loss spectrum of monoenergetic neutrons scattered from a buckyball sample was measured. Unlike more common methods such as Raman scattering and infrared absorption, which permit one measurement of only a few of the vibrational energies, neutron scattering yields a distribution that accurately reflects all the vibrational modes of a molecule. When the new data were compared with existing theories, it became evident that more accurate quantum mechanical calculations would be necessary in order to predict the properties of C_{60}. Basic understanding of the molecule will undoubtedly be useful in developing new carbon chemistry with buckyballs as the starting material. Collaborative experiments involving additional university and industrial groups are planned.

NIST BEGINS CIGARETTE FIRE SAFETY PROGRAM

Cigarette-initiated furniture fires continue to be the leading cause of fire deaths in the United States. The Fire-Safe Cigarette Act of 1990 (P.L. 101-352) directs an assessment of the practicability of developing a performance standard to reduce cigarette ignition propensity. NIST has begun research on two of its three specified tasks: (a) development of a standard test method for cigarette ignition propensity; and (b) developing experimental understanding and computer modeling of the ignition process. Upon completing these, NIST is to compile performance data on currently sold cigarettes. The project will be completed by August 1993.

NIST PRODUCES STANDARD REFERENCE MATERIAL (SRM) FOR MAGNETIC TAPE CARTRIDGES

NIST Special Publication 260-115, *Standard Reference Materials: Calibration of NIST Standard Reference Material 3201 for 0.5 Inch (12.65 mm) Serial Serpentine Magnetic Tape Cartridge*, describes the test system design and operation for the calibration of the NIST secondary standard reference tapes SRM 3201 for 0.5 in (12.65 mm) 22 and 48 track serial serpentine magnetic tape cartridges. The production of an SRM for these cartridges promotes the ability to interchange data both within and among various computer systems. When the media is designed and manufactured on the basis of a comparison to a known and accepted standard reference media, reliable interchange is assured.

REFERENCE MATERIAL 8455—PYRITE ORE FOR BIOLEACHING STUDIES

The Standard Reference Materials Program announces a new reference material (RM) for use in determining the rate of biological attack on pyrite and for use as a bioleaching substrate. The rate of bioleaching of iron from the pyrite by Thiobacillus ferrooxidans, 12.4 ± 4.0 mg Fe per L per h, is reported for information only and is not certified. This rate was determined by NIST and eight cooperating laboratories in accordance with ASTM Method E 1357-90. The composition of the material, also reported for information and not certified, is 47.0 ± 0.94 percent Fe and 49.6 ± 2.13 percent S. The RM is available in 100 g bottles of the -165, $+250$ mesh fraction of the mineral (which was washed, rinsed, and dried under nitrogen before grinding), bottled in a high-purity nitrogen atmosphere, with the bottles vacuum-sealed in foil pouches.

NIST STRUCTURES AND PROPERTIES DATABASE

Standard Reference Database 25—NIST Structures and Properties Database and Estimation Program is now available from the Standard Reference Data Program. This unique database contains data for nearly 5,000 compounds from three well-established and widely used databases—NIST Positive Ion Database, NIST Chemical Kinetics Database, and NIST JANAF Thermochemical Tables. It combines a database of properties and structures, a data prediction program, and an easy-to-use structural drawing module. It also features a complete

implementation of Benson's Group Additivity estimation for gas phase heats of formation, entropies, and heat capacities, as well as a structure-based method for estimating vapor pressures and boiling point. The database is already generating great interest.

MAGNETIZATION STUDIES OF SINTERED HIGH-TEMPERATURE SUPERCONDUCTOR $YBa_2Cu_3O_7$ CONTRIBUTE TO UNDERSTANDING OF GRAIN BOUNDARIES

NIST scientists have completed a study of the intergranular magnetic properties of the sintered, high-temperature superconductor $YBa_2Cu_3O_7$. Practical applications of high-temperature superconductors require these materials to support usefully high transport currents; grain boundaries in sintered materials are known to limit the transport current. To measure the intergranular magnetization directly, the researchers designed and constructed a field-compensating Hall-probe magnetometer; the results show that the magnetic properties of the intergranular material are analogous to those of proximity-coupled niobium-titanium filaments embedded in a copper matrix. This finding suggests that superconductor-normal-superconductor junctions exist at the $YBa_2Cu_3O_7$ grain boundaries. The magnetization of sintered materials has two components: one arising from the intrinsically superconducting grains and the other from the material that separates the grains. This intergranular material behaves as a weak type-II superconductor as a result of microbridges or proximity coupling between the grains. The team also measured the effect of transport current and applied fields on magnetic flux creep. They found that flux creep is very small at the grain boundaries and that it increases rapidly with small transport currents or applied magnetic fields. These results are significant because they provide detailed information on the flux pinning mechanisms at the grain boundaries.

HARD DISK RECORDING HEAD APPLIED TO EDDY-CURRENT PROBING

A NIST scientist has constructed and tested a novel eddy-current probe made from a computer hard-disk drive recording head. He demonstrated the capability of the probe by measuring a 2 mm long fatigue crack in 7075-T6 aluminum and two electrical-discharge-machined notches in Inconel 718 having lengths of approximately 0.5 and 0.25 mm. Advantages of the design include commercial availability of the critical sensing element and capability to detect small flaws in low-conductivity alloys. Non-destructive eddy-current flaw detection methods are becoming increasingly important in the early detection of fatigue cracks in aircraft structures and critical components such as engine fan disks.

STEP ON-LINE INFORMATION SERVICE DEMONSTRATED

The Information Services Center of the National PDES Testbed at NIST demonstrated the "STEP On-Line Information Service" at the joint IPO/ISO meeting, recently, in San Diego, CA. The IGES/PDES Organization (IPO) and the International Organization for Standardization (ISO) are two of the major organizations involved in developing an international standard for sharing digital product data for manufactured parts, the Standard for the Exchange of Product Model Data, or "STEP." Two other key organizations involved are the National PDES Testbed at NIST and PDES Inc., an industrial consortium. The STEP On-Line Information Service provides electronic access to the latest copies of the developing standard and related information. Three access methods are provided: a bulletin board system (bbs), a network file transfer protocol (anonymous ftp), and an electronic mail server. A help sheet is also provided on-line. The complete system documentation is contained in NISTIR 4491, *STEP On-Line Information Service User's Guide, and NISTIR 4508, The National PDES Testbed Mail Server User's Guide.*

SUPERCONDUCTING YBACUO PRODUCED IN AN AEROSOL FLAME REACTOR

Aerosol routes to the production of powders are increasing in importance due to their inherent advantages in product purity and process scale-up. Work at NIST has demonstrated the production of submicron $YBa_2Cu_3O_7$ particles in a diffusion flame reactor. The particles were unagglomerated and had a critical superconductivity temperature T_c of 92 K.

In this new flame synthesis method, droplets of an aqueous solution of yttrium, barium, and copper nitrates are entrained into the flame reactor by a dried stream of oxygen gas. A hydrogen-oxygen coannular diffusion flame, with the oxidant in the inner stream, produced the desired yttrium-barium-copper oxide. This configuration provided the best control of residence time and time-temperature history in the flame reactor. Premixed flames were also studied; but they did not produce the desired oxides, presumably because of the long residence time of the particles in an environment with a

high-water concentration. These novel processing techniques are critical to the production of superconducting oxides in bulk quantities.

CONCENTRATION HISTOGRAM IMAGE TECHNIQUE

NIST researchers have adapted a scatter diagram technique to help characterize the chemistry of materials by means of compositional mapping techniques. These mapping techniques involve analytical electron microscopes, electron probe microanalyzers, and other instruments that yield images depicting the microstructure and concentrations of the elemental or molecular constituents in the specimen. The spatial relationships among the constituents and their concentrations are difficult or impossible to deduce from gray level images alone, but these relationships appear at a glance in the concentration histogram image (CHI), a transformation of the images. The CHI is much like a bivariate or trivariate histogram of the images but is displayed using a modified hot-body color scale to indicate the areas in the histogram that correspond to a particular chemical composition. The CHI has structures like blobs or stripes that correspond to particular phases, phase boundaries, or diffusion zones in the material under examination. The CHI aids in discovering concentration relationships not easily found using conventional numerical statistical methods. Research continues on methods for displaying CHIs of more than three constituents and for discovering CHI features characteristic of various types of specimens and instrumental artifacts.

MAGNETIC COUPLING IN THIN FILMS STUDIED WITH "ATOMIC WEDGE"

Scientists at NIST have discovered a new effect that may affect our understanding of exchange coupling in thin-film magnetic structures and the application of the giant magnetoresistance effect to magnetic recording devices. The antiferromagnetic exchange coupling in transition metal multilayer structures has recently caused much excitement because of the resulting giant magnetoresistance and its potential application to magnetic recording. Oscillations, ferromagnetic to antiferromagnetic, in the exchange coupling between two iron (Fe) layers separated by an "atomic wedge" of chromium (Cr) were investigated by scanning electron microscopy with polarization analysis (SEMPA). The direction of the magnetic field on the upper Fe layer reversed periodically as the thickness of the Cr layer increased by multiples of 10-12 atomic layers. The magnetic oscillations persist for a startling six periods, i.e., through 70 atomic layers with a total thickness of about 100 Å. Additional, secondary oscillations with a period of two Cr layers were also observed for the first time. This observation of oscillations, with both a long and a short period, provides a fascinating set of clues for advanced theories of the exchange coupling in these structures.

COINCIDENT FRAGMENTS OBSERVED IN UNIMOLECULAR DECOMPOSITION REACTIONS

Using pulsed nanosecond lasers, NIST scientists have measured recoil velocities with unprecedented resolution for fragments produced in molecular decomposition reactions. Measurements of this type are of great importance because they elucidate the forces acting in molecules at energies where chemical reactions occur. These forces are ultimately responsible for the rates and products of chemical reactions. In diverse fields such as atmospheric and biological chemistry, it has generally been assumed that forces acting in vibrationally energized molecules would scramble quantum states of the separating fragments, producing no particular product state correlations, with no dependence upon initial vibrational motion. The results contradict previous intuition. Analogous to coincidence measurements in particle physics which have advanced understanding of subatomic structure, these chemical coincidence experiments challenge our understanding of unimolecular decomposition and should lead to greater insight into chemical processes.

In the experiment, the nitric oxide dimer (ON–NO) is excited to specific vibrational levels sufficiently energetic to lead to dissociation, producing two NO fragment molecules. The recoil velocities of the fragments are determined by measuring their Doppler-shifted absorption spectra. The extraordinary spectral resolution of the measurements allows a determination of the relationship between the energy states of related fragments and thus provides a remarkably detailed picture of the mechanics of the dissociation event. A most surprising observation is that there is a pronounced correlation of the electronic states of coincident fragments, e.g., the electronic motion observed in one fragment is always associated with a distinct electronic motion in that fragment's separating partner. The specific correlation observed represents a unique reaction path and depends upon the vibrational motion which is initially excited in the dimer.

NEUTRON SPECTROMETER DEDICATED

On May 10, the first participating research team (PRT) instrument of the Cold Neutron Research Facility was dedicated. The instrument, the 30 m small-angle neutron scattering (SANS) spectrometer, will provide the first state-of-the-art high-resolution SANS capability for U.S. researchers. Direct application to research and development on advanced materials in such areas as new polymer blends, microemulsions, packaging materials for electronics, and new metal alloys is under way.

PRT instruments are those in which organizations provide initial funding for instrument development, and continuing support for operation and upgrades in return for a share of scheduled instrument time. One-fourth of instrument time on PRT instruments is allocated to the U.S. scientific community by a program advisory committee through a proposal review system.

NANOMATERIALS AND PROCESSING

Recent research at NIST has shown that small metallic clusters of nanometer dimensions can be dispersed in dielectric or dissimilar metallic matrices by sol-gel and controlled precipitation techniques. Many of the resultant bulk materials, referred to as functional nanocomposites, show interesting properties as a result of selection of the matrix in combination with the oxidation state, small crystallite size, and distribution of the functional component. The prototype systems under study suggest that the properties of these materials can be engineered toward specific applications through judicious chemical design. Functional nanocomposite materials are projected to have significant future applications in high-density magnetic recording, magnetic refrigeration, microwave communications components, electric motor and transformer cores, as well as in magneto-optical and electro-optical devices.

EDDY-CURRENT SENSING OF OXYGEN IN HIGH-T_c SUPERCONDUCTING OXIDES DURING PROCESSING

The important low-temperature superconducting properties of high-T_c ceramic oxides are strongly dependent on parameters of the high-temperature processing of these materials. In particular, oxygen content, which affects the superconducting transition temperature, is determined not only by the detailed thermal history and surrounding atmosphere during processing but also by the porosity and surface conditions of the ceramic. This complicated situation suggests a need for sensors that can monitor the oxygen content during heat treatment. Scientists at NIST have devised a non-contacting eddy-current technique, which uses measurements of normal-state resistivity as a monitor of oxygen in cylindrical samples. The sensor consists of a coil that surrounds the sample and is connected in parallel with a capacitor. Measurements of the impedance of this circuit at resonance are used to calculate the resistivity of the sample. The physical simplicity of this device allows it to be easily incorporated into most existing research furnaces used for processing high-T_c ceramics.

NIST ASSISTS HUD IN REVISION OF MANUFACTURED HOUSING STANDARD

Researchers at NIST have completed analyses and recommended that all single-wide and double-wide mobile homes be equipped with mechanical ventilation having a minimum capacity of 0.026 m^3/s of outdoor air in future versions of the HUD standard. The analysis was completed for all geographic locations in the continental United States. Results indicate that natural ventilation was inadequate to provide the fresh air requirements specified in the latest standard of the American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Standard 62-1989, "Ventilation for Acceptable Indoor Air Quality." Additionally, considerably larger ventilation rates than were recommended would be needed to prevent condensation on single-pane windows during the heating season. Consequently, NIST recommended double-pane windows be required in all heating climates. The recommendations are currently under consideration by HUD. Additional analyses are near completion on attic ventilation requirements to prevent condensation problems.

NIST COMPLETES PREOCCUPANCY TESTING IN NEW GSA BUILDING

As part of a multiyear investigation of the thermal and indoor air quality performance of three advanced technology government office buildings, NIST researchers have just completed preoccupancy testing of the new Federal Records Center in Overland, MO. Under NIST guidance, GSA has equipped the building with a "diagnostic center," with test equipment and a terminus for sensor lines transmitting building performance data from throughout the building to monitors and data acquisition systems. The unique aspect of this building is that the occupants are moving from an existing facility that is physically linked to the new building. After moving, the old building will be

renovated and the indoor air quality in the new building is expected to be affected by the construction activity. To date, measurements have indicated a surprisingly leaky (air), but otherwise thermally efficient building envelope. Also, pollutant levels of radon, formaldehyde, volatile organic compounds, carbon monoxide, and carbon dioxide are generally below acceptable limits. Several episodes of elevated levels of CO_2 and CO have occurred during the evening due to elevated levels outdoors that are still under investigation. This study will continue through the first year of occupancy to observe the effects of new building materials outgassing and occupant activities.

NIST GIVES GSA TECHNICAL BASIS FOR USE OF ADVANCED BUILDING CONTROLS

NIST staff have provided GSA with both a design guideline and a specification in the format of MASTERSPEC so GSA personnel and their design contractors can use direct digital controls (DDC) in all future buildings. Direct digital control of heating, ventilating, air conditioning, fire safety, and building security systems has great promise over more conventional analog control systems in providing reliability, versatility, and improved performance. Because their costs have been reduced significantly during the 1980s, they are now an attractive alternative. The documents were developed based on NIST studies with DDC in laboratory experiments on commercial building heating and cooling equipment and with computer simulation models of mechanical systems and their control.

WORKSHOP FOCUSES ON APPLICATIONS PORTABILITY AND OPEN SYSTEMS ENVIRONMENTS

NIST sponsored the seventh in a series of Applications Portability Profile/Open Systems Environment (APP/OSE) Users' Forum Workshops recently. The semiannual workshops provide users and suppliers with status updates on the various functional areas of the APP and on NIST proposals regarding the adoption of an integrated set of nonproprietary standards to support applications portability. Over 230 users and vendors attended the 1 day workshop.

Highlights included specific reports by NIST personnel on the status of the APP/OSE effort; an overview of the philosophy behind a new publication, NIST Special Publication 500-187, *Application Portability Profile, The U.S. Government's Open System Environment Profile—OSE/1 Ver 1.0*, and the rationale of decisions made about comments received on the draft document; a presentation on the European view of conformance testing by members of the National Computing Centre in the United Kingdom; and a report on the newly available Portable Operating System Interface for Computing Environments (POSIX) Conformance Testing for Federal Information Processing Standard (FIPS) 151-1. The next APP/OSE workshop will be held Nov. 12, 1991.

GAMS CLASSIFICATION SYSTEM ADOPTED BY NAG LTD.

The NIST Guide to Available Mathematical Software (GAMS) Problem Classification System has been adopted by the Numerical Algorithms Group (NAG) Limited of Oxford, U.K., for use in documenting their principal mathematical software library product. NAG develops and markets mathematical and statistical software worldwide.

The GAMS Problem Classification System is a taxonomy of mathematical and statistical problems amenable to solution by existing software. It was initially developed by NIST in the early 1980s and has been periodically revised since then. It is now used widely as a tool by commercial vendors as well as in government, industrial, and university computer centers.

REFERENCE MATERIALS 8495 AND 8496—NORTHERN SOFTWOOD AND EUCALYPTUS HARDWOOD BLEACHED KRAFT PULP

The NIST Standard Reference Materials Program announces the availability of two new Kraft Pulp Reference Materials (RMs) intended primarily for use in fundamental studies on the physical properties of fibers and paper sheets. RM 8495 is a Northern Softwood Bleached Kraft Pulp and RM 8496 is a Eucalyptus Hardwood Bleached Kraft Pulp. The materials selected for these two RMs are bleached dried lap pulp, each from a single lot of a standard commercial production run. The materials were selected because of their differing fiber size, differing papermaking properties, and similarity to commercially available materials.

RMs 8495 and 8496 were developed and prepared with input and support from the Pulp Material Research Committee, a sub-committee of the Fundamental Research Committee.

The two pulp RM were donated by Aracruz Celulose S. A. and the Procter and Gamble Cellulose Company. At this time no extensive property measurements have been made on these materials beyond ensuring they were within the control limits

of the normal production run. A measurement error study is in progress with participation by international paper technical laboratories. As results become available, they will be published and added to the Report of Investigation that accompanies each of these materials.

Each RM package contains 10 standard lap sheets, each sheet weighing approximately 0.5 kg (1 lb), dry weight. The sheets are hermetically-sealed in a film foil barrier bag and packaged in a 200 lb C flute carton with dust flaps.

LITHOGRAPHED ANTENNAS PROVIDE 15×INCREASE IN EFFICIENCY AT INFRARED WAVELENGTHS

NIST scientists have developed and demonstrated the operation of a lithographed log-periodic antenna for infrared radiation that offers about a 15 times higher efficiency than the best previous measurements at the wavelength of interest and extends the wavelength range of lithographed antennas to shorter wavelengths by a factor of almost ten, toward the near infrared. The lithographic methods used are based on those used in the semiconductor industry to pattern planar integrated circuits. The team has demonstrated 50 percent efficiency in collecting a single mode of 300 K blackbody radiation, a band from about 50 to 30 μm wavelength. The thin-film antenna elements are made from a high-conductivity normal metal in a toothed spiral configuration with an overall diameter of about 60 μm, about the diameter of a human hair. The antenna fabrication method and design offers the possibility of radical new approaches to infrared detection, using detectors much smaller than the infrared wavelength. The antenna was initially designed to be used in conjunction with a kinetic photoinductive detector at its feed.

OPTICAL MODELERS COMPARE RESULTS

Modeling is one way to achieve resolution in optical metrology that exceeds the classical resolution limits of the microscope used. The modeling effort, however, is not trivial because the complete optical instrument must be analyzed including the illumination optics, the optical scattering (or diffraction) at the object, and the imaging optics. If done properly, one can achieve meaningful measurements with precisions in the nanometer range and accuracies limited by the imperfect geometry of the actual present-day micrometer- and submicrometer-sized objects.

Thus the end product of a recent optical metrology workshop at NIST was an agreed upon set of structures for which the scattered optical field will be computed by the different methods currently being studied throughout the world and then compared. Any significant differences will then be analyzed and, if necessary, corrections made to the present algorithms of computation. Once theoretical agreement is obtained for the scattering portion of the problem, real images will be computed and compared with experimental data. This comparison will require identifying, measuring, and then modeling all the imperfections of the actual experiment. Since this will be difficult, it was decided to perform a "theoretical round-robin" first.

NIST, APL EXTEND STUDY OF AUTOMATED ELECTRONICS ASSEMBLY

NIST and the Applied Physics Laboratory (APL) of the Johns Hopkins University have agreed to extend a cooperative research and development agreement to study the design of a computer-integrated small-batch manufacturing system for electronics and microelectronic parts. The study focuses on surface-mount printed-circuit boards. The project includes specification of process and quality control techniques and strategies, computer hardware and software data requirements, and interface and support standards, such as the Department of Defense CALS standards. New concepts for process control sensors will be emphasized. The joint project draws on NIST expertise in sensors and standards technology and APL skills in applications and electronics manufacture.

SIMS COMPOSITIONAL MAPPING OF ALUMINUM-LITHIUM ALLOYS

Aluminum-lithium alloys represent promising materials for aerospace applications because of their favorable mechanical properties, particularly the strength-to-weight ratio. Unfortunately, these alloys are more susceptible to oxidation than Li-free Al alloys, because the oxides of Al-Li alloys are non-protective and spall during temperature cycling. Preferential oxidation of Li at the alloy solutionizing temperature creates a Li-depleted layer extending several tens of micrometers into the metal below the oxide. The nature of this solute-depleted layer has been studied by compositional mapping secondary ion mass spectrometry (SIMS) in a collaboration involving scientists from NIST and Lehigh University. Because the depth of solute depletion (10–100 μm) is too great to apply conventional SIMS sputter depth profiling, lateral

profiling in the ion microscope imaging mode has been used to examine the extent of Li depletion, and to monitor changes in other alloying elements, including Mg and Cu. SIMS compositional mapping has enabled measurement of diffusion coefficients for the alloying elements under realistic processing conditions. This information is critical for developing thermal processing strategies for these advanced alloys.

ULTRACOLD ATOMIC COLLISIONS

Rapid advances in laboratory techniques for laser cooling and trapping of neutral atoms at temperatures below 1 mK offer many new opportunities to science and technology, including greatly improved time and frequency standards and the ability to study the very novel physics which characterizes the collisions of such atoms. A NIST scientist has just completed a detailed study of how atomic collisions cause leaks in ultracold atom traps. Otherwise contented, laser-trapped atoms can suddenly find themselves leaving their happy home due to molecular processes that heat them up during the course of an ultracold collision. The most prominent cause of heating is a change in the fine structure state of the upper level of the laser cooling transition. The colliding atoms pick up kinetic energy equal to the energy of the fine structure splitting. This energy is much larger than the trap depth and the hot atoms escape. The calculated rate of the fine structure changing process for cesium atom collisions agrees well with experimental data at 300 K and 300 μK. The rate at 300 μK, more than 2 orders of magnitude smaller than expected, is explained by a new low-temperature effect, the suppression of an excited state collision rate due to radiative decay during the long time of the collision. There is a wide range of variation in mechanism and magnitude of the predicted loss rates for traps of lithium, sodium, potassium, and rubidium. These predictions will be tested by experiments at NIST and other laboratories in the future.

COMPOSITE MATERIALS

Composite technology under study at NIST involves electrochemically depositing a sequence of alloys at high speed on moving continuous fibers which are either single or in the form of twos. The final form of the composite is achieved by hot isostatic pressing or hot pressing. The matrix material which is in general an alloy of aluminum with titanium constitutes the dominate coating and is electrochemically produced from chloroaluminate-based fused salt electrolytes. Recently NIST has demonstrated the technology to deposit aluminum alloys on over 300 m of single fiber from the fused salt. The coated fiber, a tungsten wire 15 μm in diameter, was subsequently consolidated by hot isostatic pressing into a composite.

CATHODOLUMINESCENCE IMAGES OF CVD DIAMONDS

Cathodoluminescence (CL) imaging and spectroscopy in the scanning electron microscope provides information about the spatial distribution and atomic structure of defects in chemical vapor deposited diamond. Defect luminescence may provide the basis for visible light-emitting display applications; also, defects that are observable by luminescence may affect the electronic properties of diamond. Images of the CL from two separate spectral regions, corresponding to two distinct defect luminescence bands, were obtained and examined by NIST scientists in a number of diamond particles. In some particles, CL images viewed in the two spectral regions show complementary intensities; that is, the bright areas in one spectrally resolved image are dark in the other spectrally resolved image, and vice versa. In other particles, the images viewed in the two spectral regions are similar in appearance. A model of competing recombination centers has been developed to explain this result. In a given particle, the observation of complementary images implies that only two types of defects provide the dominant decay paths for excited electrons. Noncomplementary images imply that additional decay paths due to other types of defects, not observed by CL, are also present.

HAZARD I, VERSION 1.1 COMPLETED

NIST has prepared the first update to its prototype methodology to assess the relative contributions of potentially flammable commercial products (e.g., furniture, beds) to deaths in building fires. Over 400 copies of the original version, released in mid-1989, are in use worldwide. The method is designed for single-family homes, where 80 percent of the U.S. fire deaths occur, but is adaptable to other buildings. It helps the user define first the fire problem of concern and then the specific fire factors contributing to the problem. NIST-developed (PC compatible) software then calculates the outcome of each of the fires, enabling the user to analyze the impact of making changes in the product or other features of the fire. The new modifications allow for more complex fuels, enable hydrogen chloride to deposit on walls, and include the effects

of forced ventilation on smoke transport, as well as a number of improvements in the user-friendly software. A fully revised user's guide and technical reference are included. The new version will be issued as NIST Handbook 146-1 and will be distributed by the National Fire Protection Association and the National Technical Information Service.

U.S.-JAPAN COLLABORATION ON EARTHQUAKE FIRE SAFETY OF WOOD-FRAME HOUSING

Under the sponsorship of a trade association, NIST scientists will be participating with Japanese colleagues on fire testing of wood-frame structures. Under a U.S.-Japan treaty, the Japanese are modifying the earthquake-safety provisions in their building code to allow wood-frame construction for buildings up to three stories. There is, however, a concern that the damage from an earthquake might reduce the fire resistance of the walls, floors, and/or ceilings. This would, in turn, increase the likelihood of a room fire growing to involve a full "subdivision" of closely-spaced houses. NIST staff will work with the Japanese in planning and instrumenting a fire test of a dwelling with simulated earthquake damage and then interpreting the results. It is anticipated that a successful test program will help increase U.S. wood exports.

Standard Reference Materials

STANDARD REFERENCE MATERIAL 2136— CHROMIUM/CHROMIUM MARKER LAYER THIN-FILM DEPTH PROFILE STANDARD

The Standard Reference Materials Program announces the availability of SRM 2136. It is intended primarily to provide a means for determining sputtered depths as well as sputter erosion rates in surface analysis. It was specifically developed for use in secondary ion mass spectrometry but can be used with other surface analysis techniques as well. Determinations of sputtered depth can be made at seven depths with this one SRM using chromium oxide interfaces of known spacings. The calibrated structure of this SRM makes it useful for verifying correct instrument operation, monitoring ion beam current-density stability, and producing sputtering conditions that achieve maximum interface resolution. The very thin oxide interfaces provide a means for assessing instrumental sensitivity as well as the quality of the spectral data analysis. The SRM was fabricated at the Jozef Stefan Institute, Ljubljana, Yugoslavia, and was jointly certified by NIST.

It consists of eight chromium (Cr) thin-film layers on a polished Si(100) substrate; each interface between these chromium layers is composed of a thin chromium oxide layer. This oxide marker layer is estimated to be 2 to 3 monolayers thick. The seven outermost chromium layer thicknesses are certified; the thickness of each layer is nominally 30 nm.

STANDARD REFERENCE MATERIAL 2098— CERTIFIED SAMPLES FOR CHARPY V-NOTCH TESTING MACHINES

The Standard Reference Materials Program announces the availability of super high-energy samples for Charpy V-Notch testing machines. SRM 2098 is intended primarily for checking the accuracy of large-capacity Charpy V-Notch (CVN) testing machines. These higher energy samples extend the range over which the machine performance can be evaluated and will eventually be used to join the approximately 15 and 95 J specimens now used to certify the machine performance. SRM 2098 consists of five $10 \times 10 \times 54$ mm bars of a high-strength maraging steel. The bars were fabricated from vacuum melted, vacuum arc remelted steel rods. The bars were cut to finished lengths, machined, and heat treated in SRM "lots" of 1,200 specimens. Impact energy will range between 210-224 J. NIST will evaluate the results of the test and issue a report of its findings. This report will document conformance of machine operation.

This SRM can be used as a reference material until ASTM Standard E-23 has been modified to include the use of super high-energy specimens for machine certification.

STANDARD REFERENCE MATERIAL 1474— POLYETHYLENE RESIN

The Standard Reference Materials Program announces the availability of SRM 1474. It is intended primarily for use in calibration and performance evaluation of instruments used in polymer technology and science for the determination of the melt flow rate.

This material is certified for melt flow rate using procedure A as described in Section 8 of ASTM Method D-1238-86. Standard test condition 190/2.16 was used. Thus, the flow rate was determined at 190.0 ± 0.1 °C using a load of 2.16 kg. The flow

rate of the melt was measured by a manually operated extrusion plastometer. Under this condition the melt flow rate of this material is 5.03g/10 min with a standard deviation for a single measurement of 0.037g/10 min.

The SRM is supplied as white pellets of polyethylene in a 60 g unit.

STANDARD REFERENCE MATERIAL 710a – SODA-LIME-SILICA GLASS

The Standard Reference Materials Program announces the availability of SRM 710a. It is for use in measuring the viscosity of glass in accordance with ASTM Procedure C965. Viscosities are certified over the temperature range 918-1464 °C, and the consensus fit of the viscosity-temperature data provided by 10 cooperating laboratories to the Fulcher equation are given. The softening point temperature of 730.6 1.3 °C of the glass as measured by ASTM Test Method C338 is also certified. The SRM is available as a glass plate 100 × 100 × 40 mm (4 × 4 × 1.5 in).

STANDARD REFERENCE MATERIALS 1084a AND 1085a – WEAR METALS IN LUBRICATING OIL

The Standard Reference Materials Program announces the availability of two renewal SRMs for use in the calibration of apparatus and in the evaluation of methods used in the analysis of engine lubricating oils for metal content. SRMs 1084a and 1085a consist of a blend of 14 constituent elements in a base oil with a nominal concentration of 100 and 300 μg/g, respectively. A unit of each SRM consists of five ampoules each containing 1.6 g of the respective oil blends. Spectrometric analysis of lubricating oils for wear metal content is being used extensively in large sectors of the transportation industries and in the three branches of the military. All major airlines in the United States monitor engine wear status through spectrometric oil analysis of engine oils. All major railroads in the United States monitor the wear status of diesel engines. The Department of Transportation (DOT) monitors the wear status of bus engines for vehicles owned or subsidized by DOT. The accuracy of the analysis is dependent on numerous experimental factors, however, the principal condition is the accurate knowledge of the concentration of metals in the reference material used for standardization. Thus, SRMs 1084a and 1085a become very important to the transfer of accuracy for wear metal analyses. The preparation and certification of these SRMs were performed in the NIST Ceramic and Inorganic Analytical Research Divisions.

STANDARD REFERENCE MATERIAL 2694a – SIMULATED RAINWATER

The Standard Reference Materials Program announces the availability of a renewal lot of SRM 2694a, Simulated Rainwater. The SRM consists of four 50 mL solutions, two at each level of acidity, in polyethylene bottles. It was carefully prepared by the dissolution of NIST high-purity salts and acids in high-purity distilled, deionized water. SRM 2694a is intended to aid in the analysis of acidic rainwater for measurements of pH, acidity, electrolytic conductivity, nitrate, sulfate, and a selected number of the alkali metals. In addition to the certified constituents and parameters, the SRM is accompanied by a document which provides guidelines for the accurate measurement of pH in acidic rainwater. The intent of the guidelines is to improve the accuracy and precision of the pH measurement with special emphasis on reducing the effect of the residual liquid junction potential. This was the first certified reference material of its kind and is a widely accepted measurement transfer standard for aqueous deposition research. The renewal certification of this SRM was performed in the Inorganic Analytical Research Division.

STANDARD REFERENCE MATERIAL 1963 – POLYSTYRENE SPHERES, 0.1 μm DIAMETER

The Standard Reference Materials Program announces the availability of SRM 1963, Polystyrene Spheres, 0.1 μm diameter. The SRM is intended primarily for use as a primary reference standard for the calibration of particle-size-measuring instruments, including optical and electron microscopes. The SRM consists of 5 mL of carboxylated polystyrene spheres in water at a weight concentration of about 5 percent. The certified number average particle diameter (0.1007 ± 0.0020 μm) was measured in air as an aerosol by electrical mobility measurements. The size distribution of the polystyrene spheres, as determined by electrical mobility measurements, is narrow with a standard deviation of 0.0018 μm excluding outliers.

This SRM completes the series of seven NIST particle size SRMs that provide a nominal size range of 0.1–30 μm. The certification measurements for this SRM was a collaborative effort between the NIST Fire Measurement and Research Division and the Particle Technology Laboratory at the University of Minnesota.

Standard Reference Data

FIRST MANUFACTURER'S USE OF NIST PC DATABASE

The NIST/EPA/MSDC Mass Spectral Database for personal computers (PCs) is the first PC version of a standard reference data product to be licensed for use by industry in a commercial instrument. A private company has incorporated the database in a new line of gas chromatography/mass spectrometers. A major international resource for analytical chemists to use in identifying unknown substances, the database contains electron mass spectra of approximately 54,000 chemical compounds and the chemical structures of more than 52,000 of these compounds. The PC version, first issued in 1987, was prepared from the NIST/EPA/MSDC Mass Spectral Database used worldwide in computer-magnetic tape format. For information contact the Standard Reference Data Program, A320 Physics Building, NIST, Gaithersburg, MD 20899, 301/975-2208, fax: 301/926-0416.

PC DATABASE ON REFRIGERANTS AND MIXTURES EXPANDED

Three refrigerant materials, R115, R125, and RC270, have been added to the NIST Thermodynamic Properties of Refrigerants and Refrigerant Mixture Database (REFPROP). The database is a personal computer (PC) software package for producing tables of the thermodynamic properties of 18 pure refrigerants, including the ethane-based compounds, and 24 of their mixtures. The software has been expanded to permit calculations of mixtures with up to five components. Some of these materials are possible replacements for environmentally unacceptable refrigerants. Users may also consider other mixtures of the 18 refrigerants. Designed for any AT- or XT-Class PC where it occupies 512 kilobytes, NIST Standard Reference Database 23, REFPROP, Version 2.0 is available for $340 from the Standard Reference Data Program, A320 Physics Building, NIST, Gaithersburg, MD 20899, 301/975-2208, fax: 301/926-0416. Users of Version 1.0 may upgrade for $90.

PRINT OPTIONS ADDED TO CHEMICAL KINETICS DATABASE

New printer and plotter options for producing high-quality, hard-copy graphics have been added to the expanded NIST Chemical Kinetics Database for personal computers. The database contains information on the rates of more than 5,700 chemical reactions, with more than 16,700 individual entries that include data on 2,800 compounds which are reactants or products. An important research tool for modeling combustion systems, gas phase reactors, chemical processes occurring in the atmosphere, and chemical vapor deposition, the database is designed for any computer using DOS 2.1 or later versions and requires a hard disk with 4 megabytes of memory. A graphics board must be used to show graphs of the reaction rate constants. Version 3.0 of NIST Standard Reference Database 17 is available for $340 from the Standard Reference Data Program, A320 Physics Building, NIST, Gaithersburg, MD 20899, 301/975-2208, fax: 301/926-0416. Users of 1.0 may upgrade for $150; users of 2.0 for $100.

ERRATA

In the previous issue of the Journal (Volume 96, Number 3, May–June 1991), the page number 385 was missing from the page due to a printing error. Also, the following two sentences of the last paragraph in the first column were partially obscured. They should read as follows: It has been maintained and modernized by Statistical Engineering since about 1966. The system provides statistical analysis, numerical analysis, matrix/array analysis, and plotting capabilities.