
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.

NIST/PRIVATE COMPANY RESEARCH MAY INCREASE LASER POWER

NIST and a private company have signed a two-year Cooperative Research and Development Agreement to develop an improved design for an external laser stabilizer. Private company researchers will team on the project with a NIST physicist who, while at Stanford University in 1984, designed an external stabilizer that reduces frequency noise without requiring optical modification of the laser. This allows the laser to operate at virtually full power. He has worked on several versions of his original design since then. Pooling their expertise, the researchers hope to improve the design even further and develop a stabilizer prototype that eventually may be licensed. The private company plans to use external stabilizers on lasers that probe spectral hole-burning effects in rare-earth, ion-doped crystals. Other potential benefits of the CRADA research include information storage applications, optical frequency standards using sharp resonances in special crystals and ultra-high resolution spectroscopy.

1993 DATES SET FOR ISDN USERS' FORUM

The North American ISDN Users' Forum has set its meeting dates for the remainder of calendar year 1993. They are June 21-25 and Oct. 18-22 (all sessions will be at NIST's Gaithersburg, MD, facil-

ity). NIUF is a cooperative industry and government activity formed by NIST in 1988. Its goal is to create a strong voice for users of the Integrated Services Digital Network—the futuristic information highway that allows users to send and receive voice, data and images simultaneously. As ISDN is developed and implemented, participation in the NIUF and attendance at its meetings can enable ISDN users to influence ISDN products to reflect user needs and identify ISDN applications. The NIUF also develops technical agreements and tests that promote uniform use of ISDN standards and help ensure interoperability of ISDN products. Last November, the NIUF co-sponsored Transcontinental ISDN Project (TRIP) '92, which inaugurated a national ISDN network based on standards and implementation agreements.

ISDN "SOLUTIONS CATALOG" NOW AVAILABLE

The North American Integrated Services Digital Network Users Forum has developed a national ISDN solutions catalog that is now available through the National Technical Information Service. Though the version being offered is still in draft form, forum officials anticipate that few, if any, changes will be made when the final edition is printed later this year. The catalog explains 38 solutions for ISDN applications that NIUF members identified as most important in a recent survey. Some of the solutions detailed include video conferencing, screen sharing, facsimile, caller ID, telecommuting and file transfer. Also listed are 116 products that 55 suppliers have identified as part of these solutions. Catalog of National ISDN Solutions for Selected NIUF Applications is available for \$44.50 (print) or \$17.50 (microfiche) from NTIS, Springfield, VA 22161, (703) 487-4650. Order by PB 93-124642.

NCWM PUBLISHES FIRST METRIC SIZE ANNUAL REPORT

In support of the Federal Government's metric transition program, the report on the 77th Annual Meeting of the National Conference on Weights and Measures has been printed on metric standard paper, size A5 (148 by 210 mm). It contains NCWM committee reports and general session speeches. International addresses were: "1993-Fortress Europe or Free-Trade Opportunity?" by the director of the National Weights and Measures Laboratory, U.K.; "Weights and Measures in Canada," by the chief of Canadian Weights and Measures; and "Legal Metrology in Europe," by the director of Technical and Scientific Services, Physikalisch-Technische Bundesanstalt, Germany. NCWM, an organization of more than 3000 weights and measures officials, and representatives of industry, consumer groups, and federal agencies, establishes uniform laws, regulations, device specifications, and tolerances that are adopted by federal, state, and local government agencies. The Report of the 77th National Conference on Weights and Measures, 1992 (NIST SP 845), is available from NCWM, P.O. Box 4025, Gaithersburg, MD 20855, (301) 975-4012, fax: (301) 926-0647.

LATEST BALDRIGE QUALITY AWARD CRITERIA RELEASED

Themes being emphasized in the 1993 criteria for the Malcolm Baldrige National Quality Award include a company's "investment in its people" and companies as good "corporate citizens." The 1993 criteria also emphasize the important role of information and analysis in decision making. Almost 700,000 copies of the criteria have been distributed since the award's beginning. Thousands of organizations use the criteria for self-assessment, training and education. Many state and international awards are based on the Baldrige Award criteria. Established by Congress in 1987, the award program promotes quality awareness, recognizes quality achievements of U.S. companies and publicizes successful quality strategies. NIST manages the award, in conjunction with the private sector. Applications for the award are due April 1. Single copies of the 1993 Award Criteria are available free of charge from the Malcolm Baldrige National Quality Award office, (301) 975-2036, fax: (301) 948-3716.

CRADA GOAL: ASSESSING BREAST CANCER RISK

NIST and an Ithaca, NY, biotechnology company are collaborating on an analytical system that could provide measurements to help doctors assess a woman's risk for contracting breast cancer. The Private company and NIST recently entered a cooperative research and development agreement to develop a commercial flow injection immunoassay system (FIIA), speeding transfer of this NIST-invented technology to the medical community. The FIIA approach uses specially designed liposomes, coated with antibodies, to detect very small quantities (10^{-12} g/g) of female estrogen hormones indicative of cancer risk. This new technique could potentially be used for routine screening in an automated and inexpensive clinical test. Furthermore, reliable risk assessment measurements could aid doctors in early cancer diagnosis and treatment, as well as help researchers evaluate cancer prevention strategies.

NEW METAL ALLOY SHOWS UNEXPECTED WEAR POTENTIAL

Preliminary tests of a new biocompatible alloy of zirconium, palladium and ruthenium show the material has extraordinary resistance to fracture and wear. The alloy was invented by a NIST physical metallurgist in the Paffenbarger Research Center. The patent is held by the American Dental Association Health Foundation, sponsor of the center at NIST. The alloy is strong enough for dental and medical devices and holds significant potential as an industrial coating where high-performance materials are required for bearing surfaces and mechanical joints. The material has proven strongly resistant to wear, corrosion and crack propagation, and none of the elements are known to involve toxic reactions. The metal could meet a need for a wear-resistant system for total hip and knee implants. Tests show that under applied stress normally large enough to produce a permanent change in shape, the alloy undergoes internal changes that actually increase its ability to resist further deformation and fracture. For information, contact Richard M. Waterstrat, B148 Polymer Building, NIST, Gaithersburg, MD 20899-0001, (301) 975-6831.

TWO FED LABS TO PURSUE “MANUFACTURING QUALITY”

Formalizing and expanding a long-standing relationship, NIST and the Department of Energy's Oak Ridge National Laboratory have launched a “manufacturing quality” initiative addressing measurement needs and other technology issues facing U.S. industry. The two labs agreed “to pursue all avenues of collaboration that can help improve the nation's ‘technological standing.’” The joint initiative—signed by NIST, DOE and the private company that manages the Oak Ridge Y-12 plant—will begin with NIST assisting Oak Ridge in characterizing the accuracy of high-performance coordinate measuring machines at the Y-12 plant. Plans also call for joint development of a NIST-DOE gear metrology center at the Tennessee facility. Services spawned by the NIST-Oak Ridge collaboration will help U.S. manufacturers of precision parts and products satisfy the ISO 9000 international market quality standards.

NEW SYSTEM HELPS DIAGNOSE, SOLVE CONCRETE PROBLEMS

Getting advice from many of the world's concrete experts on fixing cracks and other highway problems soon will be as easy as turning on a personal computer thanks to a new “expert” system being developed by NIST researchers. The system, called HWYCON, is an interactive computer program and knowledge base. It will help highway inspectors and engineers diagnose problems, select materials for new construction or reconstruction, and repair highways and highway structures such as concrete pavements and bridge columns. HWYCON contains facts and accepted practices, as well as “rules of thumb” from concrete experts at NIST and organizations such as the American Concrete Institute. HWYCON also includes explanations of terms, a list of references, and photographs and drawings. The National Research Council's Strategic Highway Research Program sponsored the design of HWYCON. It is expected to be available at a later date from SHRP.

GETTING THE COLD FACTS ON LOW-COST CRYOCOOLERS

Present equipment for cooling superconducting magnets and electronics tends to be large, expensive and less reliable than desired. This restricts most of the market to magnetic resonance imaging and a few large scientific installations such as

particle accelerators. If expected advances in high-temperature superconductor technology occur in the near future, a potentially large market will develop for small, inexpensive and reliable cooling equipment in the 30 to 80 K temperature region. A recent article in *Superconductor Industry* (Fall 1992) by a NIST researcher describes five main types of small cryocoolers (recuperative Joule-Thompson and Brayton cycles, and regenerative Stirling, pulse-tube, and Gifford-McMahon cycles), detailing their operating principles, advantages, disadvantages and relative costs. The article concludes with some observations on future trends and development needs in the field. For a copy of paper 45-92, contact Sarabeth Moynihan, MC 104, NIST, Boulder, CO 80303-3328, (303) 497-3237.

NIST, OIL COMPANY STUDY “GREEN” WASTE DISPOSAL

Scientists from NIST and a U.S. oil company are teaming up to study environmentally acceptable ways to dispose of wastes. NIST and the oil company recently signed a cooperative research and development agreement to investigate the destruction of various toxic compounds in near-supercritical water. At high temperatures (above 374 °C) and high pressure (above 22.1 MPa, or 3250 lb/in²), water exists in a “supercritical” state with properties of both a liquid and a gas. Oxidation (that is, combustion) in supercritical water is known to convert a variety of hazardous wastes into relatively benign compounds, such as carbon dioxide and inorganic salts. NIST and the oil company plan to study chemical reactions inside a reactor at near-supercritical conditions and analyze in what manner beneficial waste destruction takes place. The U.S. military and private industry eventually may use the process to turn hazardous wastes into harmless compounds.

NIST AND INDUSTRY TEAM FOR MMIC PACKAGING

NIST and a private company have signed a cooperative research and development agreement whereby NIST will characterize packaging for monolithic microwave integrated circuits. Specifically, NIST will use a microwave network analyzer to characterize the interconnections in ceramic electronic packages under terms of the one-year agreement. The private company will provide NIST with test wafers, including calibration structures specified by NIST and test structures of interest to

the company. The test wafer will include three types of transmission line: stripline, microstrip, and coplanar waveguide, each usable over a frequency range of 0.045 to 40 GHz. The test wafer also will include transmission lines of varying line widths. Results of the measurements will be published. For more information, contact Roger B. Marks of NIST at (303) 497-3037 or Martin Goetz of StratEdge at (619) 569-5000.

NIST SEEKS ALTERNATIVE SUPPRESSANTS TO HALON 1301

As part of an interagency program to screen potential alternatives to halon 1301 for in-flight fire suppression, NIST is seeking candidate chemicals, or mixtures of chemicals, for review. Submitted candidates would be in addition to the 12 already being evaluated: HFC-32, HFC-32/HFC-125 (azeotrope), HFC-227, HCFC-22, HFC-134a, FC-116, HCFC-124, HFC-125, FC-218, FC-31-10, FC-318, and NaHCO₃. Suppressants submitted for review must meet specific criteria and either be currently in commercial production or expected to be so by September 1994. NIST will not necessarily perform any laboratory tests on the submitted products. Contact Richard G. Gann, B250 Polymer Building, NIST, Gaithersburg, MD 20899-0001, fax: (301) 975-4052.

RESPONSE GROUP FORMED TO PREVENT SECURITY PROBLEMS

Government and private organizations in North America and Europe have formed a coalition to help combat and prevent the world's escalating computer and network security problems. Called the Forum of Incident Response and Security Teams, or FIRST, the group joins together various computer security incident response teams from the public and private sectors, as well as from universities. Incident response teams generally augment an organization's overall computer security efforts by focusing on computer security incidents. FIRST aims to foster cooperation and coordination in incident prevention, prompt rapid reaction to incidents, and promote information sharing among members. Response teams typically are set up to serve a defined constituency. In many cases, a team serves a single organization's computer network users. Computer vendors operate other teams and deal primarily with their specific operating systems. For more information, contact the FIRST secretariat, Dennis Steinauer, A216 Technology Building, NIST, Gaithersburg, MD 20899-0001, (301) 975-3359.

DATES SET FOR 1993 OSE IMPLEMENTORS' WORKSHOPS

The Open System Environments Implementors' Workshop (OIW) has scheduled its meetings for the remainder of calendar year 1993. They are June 7-11, Sept. 13-17 and Dec. 6-10. All meetings will be held at NIST headquarters in Gaithersburg, MD. The OIW was formed in 1983 as an open international forum with participation of more than 200 computer manufacturers, word processing vendors, semiconductor companies, communication carriers and various users from the United States and other countries. Co-sponsored by NIST and the Institute for Electrical and Electronics Engineers Computer Society, the workshop is organized into special interest groups that develop agreements for various functional and applications areas of open system environments such as electronic mail, file transfer, and network management. Workshop agreements are published and available to the public. For more information or to register, contact Brenda Gray, B217 Technology Building, NIST, Gaithersburg, MD 20899-0001, (301) 975-3664.

CRADA YIELDS EXPERT ADVICE FOR SMALL MANUFACTURERS

NIST and a private company have agreed to incorporate NIST's decision-support software package Automan in an expert system to facilitate technology transfer to small manufacturers. Under a Phase II Small Business Innovation Research grant from the U.S. Department of Agriculture, the private company is developing Production Advisor, an expert system for helping manufacturing managers analyze their production systems, establish key technology improvement goals, identify candidate technologies to meet these goals, evaluate solutions, and implement the selected technology. Originally developed for the U.S. Navy's MANTECH program, Automan implements the analytical hierarchy process, a mathematical decision tool that allows several options to be compared based on multiple, complex and not necessarily quantifiable criteria. Under the cooperative research and development agreement, Automan will be used by Production Advisor in the initial analysis of a production system and the final evaluation of technology alternatives. Although Production Advisor initially will target circuit-board assembly, the private company expects to extend the expert system easily to other small manufacturing operations.

**FOR ACCURATE LAB THERMOMETERS,
CALL NIST**

Hospital and clinical laboratories rely on precise temperature measurements to ensure accurate results for many of the medical tests they perform daily. For example, changes in temperature can affect enzyme rate analyses, pH and blood gas analyses, as well as many other measurements. To help the medical community achieve the necessary accuracy, NIST offers for sale Standard Reference Material 934, a clinical laboratory thermometer calibrated at four points. Certified at NIST, the standard reference thermometer is a 300 mm long, mercury-in-glass instrument that is calibrated at 0, 25, 30, and 37 °C. SRM 934 comes in a wooden case with a Report of Calibration and a detailed publication, Description and Use of a Precision Thermometer for the Clinical Laboratory. It is available for \$637 from the Standard Reference Materials Program, Room 204, Building 202, Gaithersburg, MD 20899-0001, (301) 975-6776, fax: (301) 948-3730.

**NEW SCANNER ACCURATELY MEASURES
MAGNETIC DOMAINS**

Thin-film magnetic read head performance depends in part on controlling magnetic domain formation. Domains can cause irreversible magnetoresistive (MR) response and Barkhausen noise. NIST researchers have developed a scanning four-probe resistance measurement system for studying and measuring the formation and movement of magnetic domains in thin-film magnetic read heads. The voltage probes have tip radii of about 0.1 μm and can be independently positioned to within 0.05 μm under video-microscope observation. Applying two orthogonal magnetic fields measures the MR response as a function of field magnitude and angle. These features provide a unique dynamic picture of the MR response of extremely small areas. The researchers found that magnetostatic interactions and nontransverse applied field components lead to the formation of domains and subsequent Barkhausen noise. Domain formation can be suppressed by reducing the magnetostatic interactions with flux closure schemes or by exchange biasing the film.

**AUTOMATED FREQUENCY MEASUREMENT
AT YOUR SERVICE**

Calibration managers in the electronic equipment, defense, aerospace, automotive and computer industries will be interested in NIST's automated frequency measurement service that increases productivity and reduces cost. Each subscriber receives a computer-controlled device that fits easily on a desktop or small table. All calibration results are displayed using high-resolution, full-color graphics, and the data are transferred simultaneously back to NIST via modem for traceability. Certification of the traceability is reported monthly to subscribers. Measurements are accurate enough to calibrate quartz, rubidium or cesium oscillators; up to four oscillators can be calibrated at one time. Since the system is completely automatic, it does not require any operator attention. For more information or to subscribe to the service, contact George Kamas, (303) 497-3378, or Michael Lombardi, (303) 497-3212, Div. 847, NIST, Boulder, CO 80303-3328.

**STEP GETS "GREEN LIGHT" TO
BECOME STANDARD**

The U.S.-led drive to create a universal system for the exchange of manufacturing product data moved closer to reality on Feb. 26 when the initial release of STEP (Standard for Exchange of Product Model Data) was approved as a draft international standard. The International Organization for Standardization (ISO) Technical Committee 184/SC4 unanimously approved the STEP release addressing drafting and mechanical design applications. Following a 6 month comment period, the draft standard will become official and will be known as ISO 10303. "This vote reflects a broad consensus across Europe, Japan and the United States that the initial release of STEP is now technically complete and that production-quality software implementations may now begin," says a NIST engineer who serves as chair of the ISO committee. Seventeen additional applications of STEP are under way. NIST coordinates much of the U.S. effort in STEP and hosts an industry-government sponsored National Initiative for Product Data Exchange at its Gaithersburg, MD, headquarters.

NIST, NTTC TEAM UP TO BOOST U.S. COMPETITIVENESS

The National Technology Transfer Center—the “information gateway” to the technologies and expertise existing in more than 700 federal laboratories—and NIST have announced a new partnership to help U.S. manufacturers become competitive internationally. Specifically, NTTC and NIST will seek to:

- cross train personnel on each organization’s mission, expertise and activities;
- establish methods for maintaining close working relationships between staffs;
- coordinate and link electronic databases and bulletin boards;
- share information on program evaluation criteria and techniques; and
- ensure that NIST’s seven Manufacturing Technology Centers have the opportunity to serve as field technical experts for NTTC.

CRADA PARTNERS TO SEEK ALTERNATIVE REFRIGERANT

The Electric Power Research Institute—the research and development arm of the electric utility industry” and NIST have signed a cooperative research and development agreement to help industry find environmentally friendly replacements for R22, a refrigerant used widely in home air conditioners and heat pumps. R22 contains hydrochlorofluorocarbons, chemicals believed to be damaging the Earth’s ozone layer and scheduled for phase out starting in 2015. Engineers at NIST will test two mixtures of refrigerants—R32/R134a and R32/R125/R134a—to determine their boiling properties and assess how well they will perform in equipment. EPRI will use the NIST data to advance its development of new heating and cooling technologies that are more efficient than existing systems, have zero ozone depletion potential and minimize greenhouse gas emissions.

COMMENT PERIOD BEGINS FOR OPEN SYSTEMS STANDARD

A coalition of government and industry organizations is seeking comments through NIST on a proposed specification that, when adopted, will become common to a variety of open systems users. The Industry Government Open Systems Specifi-

cation is designed to provide common requirements for Open Systems Inter-connection products and services, enabling the computer industry to develop products that meet the needs of a broad user market. IGOSS will eliminate the separate OSI profiles that coalition participants now use. Participants—which include NIST, the Canadian government and the electric power industry—plan to use IGOSS as the primary reference for functional profiles to be issued by individual IGOSS organizations in the future. Written comments on IGOSS’s technical content should be sent to Gerard Mulvenna, B217 Technology Building, NIST, Gaithersburg, MD 20899-0001, (301) 975-3631 by May 15.

BIOTECH FIRM ESTABLISHES CARB FELLOWSHIP

A private company has established a \$100,000 fund for a graduate fellowship in structural biology at the Center for Advanced Research in Biotechnology. The Maryland Biotechnology Institute will use the fund to award fellowships to students entering the Molecular and Cell Biology Program of the University of Maryland College Park, and who intend to carry out their graduate research at the CARB. 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. The private company, one of Maryland’s largest biotechnology employers, develops laboratory products for biological research in medical diagnostics, tissue culture, cell biology, immunology, and molecular biology; and manufactures and markets related reagents. Beginning September 1993, the \$100,000 fund for the graduate research fellowships will be paid over a 5-year period at the rate of \$20,000 a year. In consideration of this commitment, the University of Maryland has agreed to waive tuition for fellowship recipients.

NEW PAPERS ADDRESS LAB USES FOR DIODE LASERS

NIST has been a pioneer in the scientific applications of diode lasers, devices better known for their use in CD players and laser-jet printers. Two new papers are available from the institute on diode lasers: one discussing their ability to measure frequency and length, and the other detailing how to overcome technical problems with their use. In the first paper, the authors describe the development

of diode lasers that operate in the visible portion of the electromagnetic spectrum and the opportunities this offers for frequency measurements and frequency/length standards. Also highlighted is an anti-reflection coated red diode laser operating on a calcium transition at 657 nm. Among the technical difficulties discussed in the second paper are tuning problems (eliminated by using wavelength selective optical feedback) and amplitude fluctuation of the detected laser light (the authors recommend the use of electronic feedback). For copies of the two papers (designated by no. 93-6), contact Sarabeth Moynihan, Div. 104, NIST, Boulder, CO 80303-3328, (303) 497-3237.

VIDEO HIGHLIGHTS 1992 BALDRIGE AWARD WINNERS

What is quality management? Why is it important to U.S. competitiveness? How is it achieved? In a new 19 minute video, representatives from the five 1992 winners of the Malcolm Baldrige National Quality Award answer these questions and others on quality and quality management. The 1992 winners are AT&T Network Systems Group/Transmission Systems Business Unit, Morristown, NJ; Texas Instruments Inc. Defense Systems and Electronics Group, Dallas, TX; AT&T Universal Card Services, Jacksonville, FL; The Ritz-Carlton Hotel Co., Atlanta, GA; and Granite Rock Co., Watsonville, CA. The 1992 winners video is available from the American Society for Quality Control for \$20. Order item TA512 in ASQC's inventory by calling (800) 248-1946. Videos highlighting Baldrige winners from the previous 4 years also are available from ASQC.

U.S./CANADA MUTUAL TYPE EVALUATION RECOGNITION

As a result of meetings sponsored and organized by NIST, Canadian and U.S. representatives agreed to mutual recognition of type evaluation tests conducted by and for both nations. In partnership with the National Conference on Weights and Measures, state weights and measures agencies, federal agencies, and device manufacturers, NIST manages the National Type Evaluation Program, using six "participating laboratories" around the nation and four other field evaluation sites to evaluate prototype designs of commercial measuring equipment against national standards. Such varied equipment includes retail, truck, in-motion railroad and shipping scales, motor fuel dispensers, point-of-scale

systems, load cells, digital indicators, computer software, and fluid meters.

Representatives from these laboratories, the NCWM, and NIST will now work with Canada's type evaluation laboratory to compare requirements and test protocols so that manufacturers may submit commercial devices to laboratories in either or both nations. Further steps will be necessary to permit manufacturers to design to a single set of performance criteria; however, this agreement to work with Canada's legal metrology group represents the first step toward harmonization of national requirements as a means of removing barriers to trade with our largest trading partner in commercial devices.

1992 CONFERENCE OF LEGAL METROLOGY IN GREECE

A NIST scientist headed the U.S. delegation to the 9th Quadrennial Conference of Legal Metrology in Athens, Greece, Nov. 2–6. Another NIST scientist and a representative of the Department of State were members of the official U.S. delegation, which also included observers representing the NIST Weights and Measures Program, the National Conference on Weights and Measures, and a private company. Representatives of 41 of the 49 member nations of the International Organization of Legal Metrology (OIML) participated.

The conference establishes overall policy for OIML, sanctions (ratifies) the OIML recommendations approved during the previous 4 years, and establishes a budget for the International Bureau of Legal Metrology for the next 4 years. Eighteen recommendations on the performance requirements of measuring instruments were sanctioned. The United States was directly responsible for four of these recommendations (load cells, atomic absorption spectrometers for measuring metal pollutants, electronic weighing instruments, and direct mass flow measuring systems for liquids) and strongly influenced the development of four other recommendations (instruments for measuring vehicle exhaust emissions, non-automatic weighing instruments, automatic rail-weighbridges, and discontinuous totalizing automatic weighing instruments). The status of the technical work, the long-range policy, the program for developing countries, and liaison reports of cooperation with other international organizations were also discussed.

The 27th Meeting of the International Committee of Legal Metrology (CML) was held in conjunction with the conference. A NIST scientist is

the U.S. member of CIML, which develops policy for the technical activities of OIML, establishes the work structure, and approves work projects and official OIML publications (recommendations and documents). Significant decisions were made for new work procedures for developing and approving the technical work, new committee structures and associated work projects, and assignment of some new committee secretariats to member nations. The United States was assigned responsibility for five of the 18 new technical committees (metrological control; prepackaged products; instruments for measuring mass and density; instruments for measuring pressure, force, and related quantities; and instruments for measuring pollutants).

NIST SCIENTISTS ABLE TO OBSERVE ONE ELECTRON IN 10 BILLION

A NIST scientist and a guest researcher have performed an experiment that indicates the presence of a single excited electron above a condensed ground state of 10^{10} superconducting electrons. At the very low temperature of the experiment (0.035 K), electrons are bound together in pairs, the usual picture of the superconducting state which allows the dissipationless flow of electrical current. Prior to the invention of the single-particle electrometer, little consideration had been given to what would happen if there happened to be an odd number of electrons in the sample. Obviously the last one could not be paired.

The experimenters used a Coulomb-blockade electrometer composed of two ultra-small tunnel junctions fabricated by electron-beam lithography and a double-angle evaporation process. Earlier work at NIST had demonstrated that this configuration of electrometer has the capability of making the required observations, with noise levels of only 0.0001 electrons at 10 Hz. The electrometer used in this experiment differs from that reported by other workers in that it has two normal-state outer electrodes and a submicrometer superconducting central electrode, or island, a configuration designated N-S-N. The dimensions of the island give rise to the 10^{10} figure for the number of superconducting electrons involved. The use of normal-state outer electrodes in the electrometer prevents them from being a source of superconducting tunneling electrons, a problem that has confused the results from S-S-S electrometers (all electrodes superconducting) used by others. The results of this experiment have been submitted to Physical Review Letters.

FAST PULSE TEST SERVICES RE-ESTABLISHED AT NIST

Special-test services for measurements of fast electrical pulse waveforms are now operational at NIST. These services include: Impulse Generator Spectrum Amplitude (NIST Calibration Services Users Guide (SP250) Test No. 65100S), Fast Repetitive Baseband Pulse Parameters (65200S), Network Impulse Response (65300S), and Pulse Time Delay through Coaxial Transmission Lines (65400S). All of these special tests are performed "at cost"; experience suggests that a typical customer incurs fees on the order of a few thousand dollars for measurements on a single transfer standard. The NIST Automatic Waveform Analysis and Measurement System, which is the heart of the apparatus used to perform these measurements, has been installed in an electromagnetically shielded enclosure having a floor area of 5 by 5 m, ambient temperature controlled to about ± 0.5 °C, and incoming ac line power both filtered and dynamically regulated.

Initial measurement results obtained under these improved environmental conditions indicate that the measurement uncertainties are now generally smaller, in some cases by a factor of two or more. In 1993, the goals for the service are to reduce time and amplitude errors and to reflect all improvements in the services' advertised uncertainties, which are to be expressed in accordance with the International Standards Organization 9000 guidelines.

SUBMICROMETER-RESOLUTION SCANNER DEVELOPED FOR DYNAMIC MEASUREMENTS OF DOMAINS IN MAGNETIC READ HEADS

NIST scientists have developed a scanning four-probe resistance measurement system for studying and measuring the formation and movement of magnetic domains in thin-film magnetic read heads. This development responds to a need to control domain formation, which degrades device performance, leading to irreversibility in the magnetoresistive (MR) response and to Barkhausen noise, also detrimental to head performance. The upcoming generation of magnetic recording media has bit densities that challenge the capabilities of existing inductive reading methods; in response to this limitation, the cutting-edge head technology is based on MR effect in soft ferromagnetic materials.

The voltage taps are microprobes fabricated from beryllium copper with a tip radius on the order of $0.1\ \mu\text{m}$. Each probe can be moved independently of the other with a step resolution of $0.05\ \mu\text{m}$. Microprobe placement and movement are monitored by both a horizontal and vertical microscope-camera viewing system. Two orthogonal magnetic fields can be applied to the device being studied so that the MR response can be studied as a function of field magnitude and angle. The scanning system is used to measure local MR responses of the device, from which the local magnetic structure is inferred. This information indicates where and under what field conditions domains are formed. The team has found that magnetostatic interactions, along with a nontransverse applied field component, lead to the formation of domains and subsequent Barkhausen noise. Domain formation can be suppressed by reducing the magnetostatic interactions with flux closure schemes or by exchange biasing the film. The scanning microprobe system is unique in that local areas of the MR device can be measured dynamically as a function of applied field with submicrometer resolution.

NEW PROCESS PRODUCES NIST 10 V ARRAY STANDARDS WITH INDUSTRY COLLABORATION

A NIST scientist has developed a new process for fabricating 10 V Josephson-junction voltage array standards. Working jointly in the context of a cooperative research and development agreement with a private company, the process uses an SiO_2 insulating layer deposited by the company together with niobium trilayer Josephson junctions fabricated at NIST. The resulting yield of 50 percent for the process of making the 20000 junction chips, each of which constitutes an array standard and is available only from NIST, is sufficiently good that NIST has eliminated its backlog of orders for the standards and has a number in reserve. Delivery of a new deposition system for SiO_2 insulators in the spring of 1993 will return full in-house fabrication capability to NIST for the 10 V chips, and serious consideration is being given to discontinuing the fabrication and sale of the simpler 1 V, 3000 junction chips at that time. NIST anticipates that the success of the new process should make commercial production of voltage array standards possible.

NIST SCIENTIST CHAIRS WORKSHOP RESPONDING TO INDUSTRY NEEDS FOR MCT CHARACTERIZATION

A NIST scientist recently organized and chaired the Workshop on Measurement Techniques for Characterization of Mercury Cadmium Telluride (MCT) Materials, Processing, and Detectors, held in response to industry needs for enhancing the manufacturability of infrared focal plane arrays. Problems encountered have led to increasing concern that the ability to grow and fabricate device structures has outgrown the ability to provide the characterization methods needed to advance infrared detector technology. In addition, a lack of understanding of the materials-, processing-, and device-related theory underlying the use of both routine and state-of-the-art characterization methods interferes with interpretation of results.

Interest in these issues drew 117 participants for the workshop's nine invited review and 10 poster papers. Topics covered by the invited papers included how silicon materials characterization has evolved and what has been learned with silicon to improve the manufacturing of other devices based on different materials; the impact of characterization methods on MCT infrared detector technology; in-situ characterization methods for monitoring and control of vapor-phase epitaxial growth of MCT; test structures used in semiconductor electronics with applications to infrared detector materials and processes; and magneto-transport, minority-carrier-lifetime, and scanning-laser-microscopy characterization methods. The poster papers presented newly available methods, including a lifetime screening technique using transient millimeter-wave reflectance and characterizations by photo-induced microwave reflection, far-infrared photoluminescence, pulsed infrared synchrotron radiation, direct Zeeman atomic absorption spectroscopy, and Faraday rotation. The NIST scientist will serve as editor of the workshop proceedings, to be published in 1993 as an issue of *Semiconductor Science and Technology*.

NAVY PRODUCTIVITY IMPROVED WITH FASTENER WORKCELL

Since the advanced fastener workcell was installed at the Portsmouth Naval Shipyard, it has been producing level-1 fasteners. The workcell is a direct technology transfer to the U.S. Navy from the NIST Automated Manufacturing Research Facility, which is the Navy Center of Excellence for automated discrete-part manufacturing technology.

Based on a General Accounting Office study issued in its 1991 report, military safety-critical fastener products have a rejection rate of 40 percent or higher. The failure of these fastener products has caused a number of helicopter accidents. Production data of the fastener workcell for the last few months received by NIST indicate that the median production time for a fastener is about 10 min (50 percent better than the design goal of 20 min) as compared to 90 min with conventional means. Employing a variable thread measurement system and error compensation technique, safety-critical fastener production at Portsmouth, thus far, is running with 99 percent of the manufactured parts meeting specifications and a rejection rate of only 1 percent.

INFORMATION TECHNOLOGY VISION FOR THE U.S. FIBER/TEXTILE/APPAREL INDUSTRY

A NIST scientist has published a report entitled, Information Technology Vision for the U.S. Fiber/Textile/Apparel [FTA] Industry.

The ideas presented in the report were developed through interactions with the FTA industry while working on the Apparel Product Data Exchange Standard project. The goal of the project is to develop manufacturing data standards, based on the Standard for the Exchange of Product Model Data, for integrating the information needed to operate an apparel manufacturing enterprise.

The scientist's report describes the importance of the FTA industry to America's economic well-being, the threat to the industry due to imports, opportunities for the use of information technology to advance the industry and counter the import threat, and the roles the organizations involved with the industry can play. Information technology is described as the "linchpin" for the research and development required.

NIST plans to convene a workshop with FTA industry leaders to explore more fully the information technology needs of the industry and develop a plan to satisfy those needs. The scientist's report will provide a straw man for such a plan.

NIST SCIENTIST TO CHAIR NEW ISO TECHNICAL COMMITTEE ON SURFACE CHEMICAL ANALYSIS

The International Organization for Standardization (ISO) recently formed a new Technical Committee on Surface Chemical Analysis, which is designated

ISO/TC 201. A NIST scientist was nominated by the Japanese standards body (the host of the ISO/TC 201 Secretariat) to be chairman of the new technical committee, and his appointment was confirmed recently by the ISO technical board. The new technical committee was formed following a proposal from Japan and currently has 10 full participating members (the national standards bodies of Austria, Belgium, China, Germany, Japan, Russia, Sweden, Turkey, the United Kingdom, and the United States) and 15 observer members (the national standards bodies of Australia, Egypt, Finland, France, India, Ireland, Korea, Norway, Philippines, Poland, Romania, Singapore, South Africa, and Switzerland).

The official scope of ISO/TC 201 is "standardization in the field of surface chemical analysis, which uses electrons, ions, neutrals or photons both as an incident beam and a detecting signal." With current techniques of surface chemical analysis, compositional information is obtained for regions close to a surface (generally within 20 nm) and composition-versus-depth information is obtained with surface analytical techniques as surface layers are removed.

ISO/TC 201 plans to create a variety of subcommittees. One will work to promote the harmonization of requirements concerning instrument specifications, instrument operations, specimen preparation, data acquisition, data processing, qualitative analysis, quantitative analysis, and reporting of results. Others will establish consistent terminology, and develop recommended procedures and promote the development of reference materials and reference data to ensure that surface analyses of the needed precision and accuracy are made. ISO/TC 201 will also prepare draft international standards.

STOP-ACTION MEASUREMENTS OF ENERGY TRANSFER PROCESSES

In a joint research effort involving scientists at NIST, picosecond lasers are being used to determine the rates and mechanisms for energy flow from metal substrates to the vibrational modes of chemisorbed molecules. Such information is critically important to understanding chemical reactivity at surfaces since sticking, desorption, surface mobility, and chemical reactions are activated by vibrational excitation. The coupling of optical radiation to surface reactions is receiving attention in catalysis, semiconductor processing, and solar energy conversion.

In these first experiments, carbon monoxide (CO) chemisorbed at monolayer coverage on a clean Pt(111) crystal was studied because it is the adsorbate/substrate system best characterized by traditional non-time-resolved methods. The experiments have revealed a fascinating series of snapshots of a warp-speed world where changes can occur in the time that it takes light to travel a mm or so. Two laser pulses of about 0.9 ps ($1 \text{ ps} = 10^{-12} \text{ s}$) duration hit the crystal; one is a visible pump pulse, the other an infrared probe pulse which determines the energy content of the Pt and CO vibrational modes by absorption spectroscopy as a function of pump/probe time delay. The pump pulse excites the Pt substrate (initially at $T = 150 \text{ K}$) creating hot electrons near the surface (penetration depth = 15 nm). These hot electrons initially have an elevated electronic temperature $T_e \approx 250 \text{ K}$. In 1.6 ps the hot electrons equilibrate with the Pt lattice vibrations (phonons) giving $T_{\text{lat}} = T_e = 200 \text{ K}$. The hot electrons and phonons then energize one of the four vibrational modes of the chemisorbed CO, specifically the frustrated translation mode at a frequency $\nu = 1.8 \text{ THz}$ (60 cm^{-1}). The temperature T_{ads} of this mode comes into equilibrium with T_e and T_{lat} in 2 ps. If the mode is excited only by the hot electrons, then T_e and T_{ads} have a coupling time of $2 \pm 1 \text{ ps}$. If instead the mode couples only to the Pt phonons, then T_{lat} and T_{ads} have a coupling time less than 1 ps. On a longer timescale of 100 ps, the three coupled temperatures return to the initial value as heat diffuses away from the surface into the Pt crystal.

These experiments provide the first useful estimates of these energy transfer rates, which are quite fast and comparable to the 0.6 ps vibrational period of the excited mode. The NIST group is now starting experiments on other systems (e.g., CO/Cu) in order to test theories being developed by colleagues in private industry.

NEW DETECTOR-BASED PHOTOMETRIC SCALES AND IMPROVED PHOTOMETRIC CALIBRATION SERVICES

The candela scale recently was established using standard photometers calibrated against a high-accuracy cryogenic radiometer, the basis of the NIST detector spectral responsivity scale. The measurement chain was shortened significantly compared with the traditional candela scale based on a fixed temperature blackbody. This resulted in

an improvement of the scale uncertainty of a factor of 2 to 0.5 percent (3σ). Eight photometers are now maintained as the primary standards for the illuminance and the luminous intensity scales, rather than groups of lamps of different wattage.

This change makes photometric calibration services at NIST more versatile and flexible than ever before. Luminous intensity of light sources, ranging from 10^{-3} to 10^4 cd , can be calibrated directly with the standard photometers because they have a linear response over this range and an illuminance sensitivity as low as 10^{-7} lx . Users' illuminance and luminance meters can be calibrated directly against the NIST standard photometers or a calibrated integrating sphere source. The total flux of incandescent lamps, with outputs ranging from 10^{-1} to 10^5 lm , can be calibrated by direct substitution with NIST total luminous flux standard lamps—providing industry with an improved basis for measuring the performance of lamps and photometers, such as measuring the lighting efficiency (lm/W) of miniature lamps used in automotive applications.

NIST ASSISTS THE STATE OF MARYLAND IN RADIATION DOSE RECONSTRUCTION FOR AN INDUSTRIAL ACCELERATOR ACCIDENT

In December 1991, a radiation overexposure occurred at an industrial radiation facility in Maryland. An operator violated safety procedures and placed his hands, feet, and head in a high-energy electron beam resulting in severe disability. At the request of state of Maryland officials and the attending physician, a team of NIST scientists conducted post-accident radiation measurements at the facility. Radiation dosimeters were mounted in strategic locations in the accident area, and the accident conditions were reproduced according to personal accounts. The results were used by the physician to assess the degree of the exposure. In follow-up studies, bone samples from the victim were examined at NIST to measure directly the absorbed radiation dose received by the victim. A paper describing the reconstruction dosimetry for this accident has been accepted by the journal *Health Physics*. The details of the NIST and state of Maryland measurements will assist the health physics community in designing improved safety procedures to prevent future accidents and in formulating measurement protocols for accelerator accident victims.

STRUCTURAL STUDIES OF LANGMUIR-BLODGETT FILMS USING NEUTRON REFLECTIVITY

A collaborative research effort between NIST scientists and guest scientists from the Institute of Crystallography, Moscow; the Max Planck Institute for Polymer Research, Germany; and the University of Akron, Ohio, is under way to understand the microscopic structures of organic Langmuir-Blodgett (LB) film systems. The principal probe in these investigations is neutron reflectivity in which the large difference in neutron scattering power for hydrogen and deuterium isotopes, makes it possible to determine the chemical composition profile normal to the plane of the film with near nanometer resolution.

LB films, created by forming a monomolecular layer of surfactant molecules on a water surface and then transferring onto a solid substrate (and repeating several times to form multilayers), may consist of fatty acids, polymers, polymerizable compounds, and lipids, as well as proteins and nucleic acids. The applications of LB films are many. LB films are used in liquid crystal displays, resists for electrons and photon lithography, optical lens coatings, molecular lubricants, capacitors and other microelectronic devices, and biosensors. Biologically important molecules that do not crystallize, such as proteins, also can be incorporated in LB films with an artificial periodicity and specific orientations, which makes it possible to obtain unique structural information from diffraction or reflectivity measurements.

Despite all of the above-mentioned existing and potential applications, relatively little is known about the detailed, microscopic structure of the LB films themselves. Such knowledge is essential for a proper understanding of their basic properties and is the principal goal of the present research.

MAGNETIC SENSOR FOR MECHANICAL PROPERTIES

NIST is undertaking a project to develop magnetic sensors for mechanical properties. The project is scheduled to begin in CY 1993 and, if successful, the sensors could be used to monitor the properties of sheet steel on-line and, thereby, facilitate the implementation of intelligent processing systems for the steel industry. Such systems are both cost effective and energy efficient.

It has long been known that Barkhausen noise, magnetoacoustic emission, residual magnetization, hysteresis, permeability, coercive force, and flux

leakage are all sensitive, in some degree, to mechanical properties. The challenge in using magnetic measurements to monitor mechanical properties is to select that measurement, or combination of measurements, which can be made rapidly in a production environment and which will be effective in detecting changes in the properties of most interest. In preparation for this project, preliminary studies on sheet steel have been carried out at NIST. These studies showed that conditioning of the sheet, i.e., whether it was cold or hot rolled, and some of the resulting mechanical properties could, indeed, be discerned by magnetic measurements. Differences in yield strength and other mechanical properties that are strongly dependent upon ferrite grain size, and residual stresses, could be correlated with Barkhausen magnetic measurements.

FIRST DIRECT OBSERVATION OF PHOTOREFRACTIVE GRATINGS IN A NONLINEAR OPTICAL MATERIAL

The lattice deformation due to photorefractive space charge fields in a nonlinear optical material has been observed directly for the first time in recent x-ray diffraction imaging of barium titanate. The work was performed by NIST at the National Synchrotron Light Source at Brookhaven National Laboratory.

Two beams split from a 50 mW frequency-doubled YAG laser at 532 nm were used to form high-contrast fringe patterns (modulation 96 percent) with fringe periods between 7 and 50 μm . X-ray diffraction images were obtained for the piezoelectric strain pattern induced by the resulting charge redistribution. In this work, interior 180 degree crystal domains also were observed directly for the first time and identified unambiguously through their phase shift of the fringe pattern.

Direct observation both of the optically induced grating and of the 180 degree crystal domains is expected to provide guidance for improving the performance of devices made from this material for high-capacity optical information processing.

MEASUREMENTS FOR POLYMER PROCESSING CONSORTIUM

Members of the Measurements for Polymer Processing Consortium attended a semi-annual consortium review meeting at NIST in Dec. 1992. This was the first review meeting of this NIST/

industry consortium since its inauguration in June 1992. Industry representatives participated in discussions regarding industry requirements for real-time measurements of polymer processing parameters, particularly temperature and viscosity. The NIST measurement program, which is based on optical methods of measurement, utilizes optical fiber probes to monitor the state of polymer resins at specific positions in the process stream of polymer processing machinery. Introductory presentations by NIST staff included a summary of previous NIST experience of instrumenting a polymer injection molding machine and a twin screw extruder with optical fibers. Discussions of current work focused on measurement methods to monitor temperature and viscosity using fluorescence spectroscopy. The fundamental science underlying the measurement concepts was thoroughly discussed. A request from industry representatives to develop a method to measure temperature gradients (the temperature profile through a thickness of polymer resin) during processing was unanimously supported by those present. Industry representatives agreed that accurate knowledge of temperature, temperature gradients, and viscosity are needed to understand the physics of polymer processes and to optimize productivity and product performance.

NIST CONDUCTS ASSESSMENT OF VENTILATION MEASUREMENT TECHNIQUES

NIST staff conducted a study of ventilation and ventilation measurement techniques in the Bonneville Power Administration Building in Portland, OR. This project involved an assessment of outdoor air-ventilation measurement techniques for use in mechanically ventilated commercial buildings. These techniques were evaluated for the practicality of their use in the field and their reliability. The following measurement techniques were compared: tracer gas decay measurement of whole building air change rates, the determination of air change rates based on peak carbon dioxide concentrations, the determination of percent outdoor air intake using tracer gases, and direct airflow rate measurements within the air handling system using traditional engineering approaches. Airflow rates were measured in the air-handling system ductwork using pilot tube, hot-wire anemometer, and vane anemometer traverses. Good agreement was obtained between the different techniques. While accurate determinations of

percent outdoor air intake were achieved using tracer gas techniques, the use of carbon dioxide detector tubes yielded unreliable results. Reliable determinations of ventilation rates per person were made based on sulfur hexafluoride decay and direct airflow rate measurements, but the use of peak carbon dioxide concentrations led to inaccuracies, e.g., the overprediction of ventilation rates by as much as 100 percent.

NIBS PROVIDES NIST WITH RESEARCH RECOMMENDATIONS

In Dec. 1992, the National Institute of Building Sciences (NIBS) held its Research Recommendations Subcommittee meeting to discuss and prioritize building and fire research needs. Private-sector and federal agency members participated. Requests for building and fire research recommendations were polled from more than 3500 members of private and public construction and fire-related organizations. The poll seeks to determine what areas of research are most important to these organizations. Over 50 research recommendations were evaluated by four subcommittees: structures, materials, environment, and fire. Priority recommendations will be provided as input to creating the NIST program plan. The recommendations are solicited and evaluated following the criteria: national need and relevance to NIST mission, expertise, and facilities.

Since 1986, NIBS has provided NIST with recommendations for building and fire research. This NIBS activity was initiated in response to the House Committee on Science and Technology's request that NIST consult with NIBS for research recommendations. A memorandum of understanding exists between NIST and NIBS to facilitate the development of these research recommendations.

NIBS was authorized by the U.S. Congress in 1974 to improve the building regulatory environment, facilitate the introduction of new and existing products and technology into the building process, and disseminate nationally recognized technical and regulatory information. NIBS is a non-profit, non-governmental organization bringing together expertise from a representative sample of the public and private building- and fire-related organizations to focus on approaches to reduce barriers for improved building design and construction practices.

NIST DELIVERS HOME FIRE SAFETY INFORMATION TO USERS

NIST recently has completed work on a 20-page booklet entitled *Protecting Your Family from Fire*. It will be produced both in English and Spanish. The booklet includes information on home fires and how to use smoke detectors, fire alarm systems, and residential sprinklers to protect families, especially those including young children or older persons (who are disproportionately victims of fires). The booklet also provides guidance on the use of flashing lights for alerting hearing impaired persons. Numbers and locations of devices needed, as well as how to test and maintain the devices, are covered. The booklet was developed with the support of the U.S. Fire Administration, which will be handling printing and distribution.

NIST TRAINS BATF AGENTS

NIST recently conducted a 3 day workshop to introduce agents of the Bureau of Alcohol, Tobacco, and Firearms (BATF) to the use of fire models in investigating and reconstructing fire incidents. Fifteen agents, who conduct fire investigations as part of BATF's National Response Teams, participated in the workshop. BATF headquarters staff have been distributing NIST-developed software tools like FPEtool, CFAST, and HAZARD I to their field offices to enhance the technical foundation of their investigations and to improve their performance in obtaining convictions in criminal arson cases.

NEW FEDERAL INFORMATION PROCESSING STANDARDS (FIPS) APPROVED

The Secretary of Commerce has approved three new FIPS for federal agency use. FIPS 177, Initial Graphics Exchange Specification, which adopts ASME/ANSI Y14.26M-1989, will enable federal agencies to use more effective and productive computer-aided design and computer-aided manufacturing techniques.

FIPS 178, Video Conferencing Services at 56 to 1920 kb/s, supports the design and development of video conferencing systems. The referenced specifications for FIPS 178 are the CCITT Recommendations H.320, H.221, H.242, H.261, and H.230 developed by CCITT with federal government assistance. Systems developed under this standard will facilitate the interoperability of products and services from different suppliers.

FIPS 179, Government Network Management Profile, which adopts Version 1.0 GNMP, specifies the common management information exchange protocol and services, specific management functions and services, and the syntax and semantics of the management information required to support monitoring and control of the network and system components and their resources.

OPEN SYSTEMS ENVIRONMENT (OSE) IMPLEMENTORS' WORKSHOP (OIW) MEETS

On Dec. 14–18, NIST and the IEEE Computer Society co-sponsored the OIW, part of a continuing series of workshops to develop implementation specifications for computer network protocols. About 260 participants attended the meeting.

The OIW Plenary voted to use the Common Programming Interface—Communications (CPI-C) Specification as a reference in the Transaction Processing implementation agreements; the specification has recently been made publicly available. CPI-C is an application programming interface for program-to-program communications and was designed to eliminate incompatibilities between LU 6.2 variations. CPI-C is independent of the underlying transport layer protocols. This marks the first use of public specifications in implementors agreements by a regional workshop. The OIW also adopted the IEEE P1003.0 Open Systems Environment Reference Model for use in their work program.

NEW PUBLICATION FOCUSES ON AUTOMATIC INDEXING

Automatic indexing is becoming a critical technology as more full-text data become available online. NISTIR 4873, *Automatic Indexing*, provides a tutorial on the single-term indexing of "real world" text and describes advances in automatic indexing beyond the single-term indexing done in most operational retrieval systems. Whereas traditional indexing enables reasonable searching of large full-text documents, more advanced techniques raise the retrieval performance beyond the mediocre level. The document underscores the importance of continuing research in retrieval technologies and the timely acceptance of proven methodologies as standard automatic indexing techniques by the information retrieval community.

STANDARD CLASSIFICATION FOR BUILDING ELEMENTS

NIST scientists have written and NIST is distributing SP 841, entitled UNIFORMAT II: A Recommended Classification for Building Elements and Related Sitework. It provides a standard format for collecting and evaluating costs in the economic evaluation of buildings and building systems. It also provides a standard framework for other design and construction-related activities such as project descriptions and scheduling. The report responded to requests from the building community for a comprehensive standard classification based on building elements rather than building products or materials. At present no such standard exists in North America. The NIST report is the technical basis for the ongoing development by ASTM of a standard classification for building elements and related sitework. It is also the basis for the Construction Specifications Institute's (CSI's) in-press publication entitled *Uniformat: A Uniform Classification of Construction Systems and Assemblies*. Adoption by ASTM and CSI of NIST's UNIFORMAT II classification will assure its widespread acceptance and use in North America.

WORKSHOP ON EXPERIMENT DESIGN FOR SCIENTISTS AND ENGINEERS

NIST recently held the workshop "Experiment Design for Scientists and Engineers." NIST instructors presented the latest statistical experiment design techniques for improving product and process quality to 24 engineers from regional industries. The engineers had primarily research and development responsibilities and represented a wide spectrum of small to medium-size companies dealing in electronics, communications, chemicals, materials, food, and paper.

The workshop covered comparative designs, full and fractional factorial designs, response surface methods, and Taguchi's approach to reducing variability. The concepts underlying designed experiments were reinforced through hands-on experiments—the students found this feature of the workshop very effective. Students felt the techniques presented would be particularly useful for improving their own product and process quality. NIST plans to offer this workshop on the west coast in the summer of 1993.

U.S. AND CANADA PUBLISH HARMONIZED PERFORMANCE STANDARDS ON PLYWOOD SHEATHING

Harmonized national performance standards for plywood and other wood-based panels (oriented strand board, waferboard, and particleboard) recently have been published as DoC Voluntary Product Standard PS 2-92 Performance Standards for Wood-Based Structural-Use Panels in the United States and as CAN/CSA-0325.0-92 Construction Sheathing in Canada. The U.S. standard was developed and published under DoC procedures at NIST and approved on Aug. 27, 1992.

The standards were developed at the request of a special Binational Committee on Plywood (BNC), appointed by the U.S. and Canadian governments, to resolve issues that were delaying the implementation of the United States-Canada Free Trade Agreement of 1987 (CFTA) with regard to plywood sheathing. The United States was concerned that certain U.S. plywood sheathing was not permitted to be sold in Canada.

An official from the Standards Management Program at NIST represented NIST as an observer in the BNC deliberations and served as secretary of the Standard Review Committee that developed the DoC Voluntary Product Standard for which the American Plywood Association provided financial support.

The Canadian standard now has been incorporated into the National Building Code of Canada, and the U.S. standard has been incorporated into National Evaluation Report NER-108 of the four U.S. model building code organizations (SBCCI, BOCA, CABO, ICBO). With the incorporation of the performance standards into the national building codes, a presidential proclamation was issued in December 1992 that approved staged U.S. reductions in duties on certain plywood originating in Canada on Jan. 1, 1993, in accordance with the provisions of the CFTA.

NIST DISCOVERS "SAND" ON YBCO THIN FILMS

NIST scientists have discovered the hitherto unsuspected existence of insulating nanometer-scale particles on thin films of various specimens of high-critical-temperature yttrium/barium/copper oxide (YBCO). Since the presence of the "sand" affects the film's properties, this discovery is an important

contribution to improved understanding of the films and to their successful exploitation in practical electronic devices, particularly devices using multilayer structures.

The NIST team also suggests that the particles may be the natural pinning sites responsible for the high critical currents observed in YBCO thin films, to date an unresolved issue. The scientists used both scanning tunneling microscopy (STM) and atomic force microscopy (AFM) to examine the surface morphology of specimens prepared by NIST colleagues and by a private company. These methods have the capability of resolving nanometer-scale features, such as individual growth steps on the surface of submicrometer grains, difficult if not impossible to image by other means.

The scientists found that the AFM images revealed the presence of a high density of individual particles, 10 to 50 nm across and 5 to 20 nm high. The STM images did not show these particles, presumably because they are insulating (STMs sense a tunneling current and thus only "see" conducting surfaces). However, subsequent AFM images showed that the STM tip breaks off the particles during scanning and moves them to the edges of the scanned area. AFM images of films from 12.5 to 400 nm in thickness, prepared over a range of deposition temperatures, and on substrates including buffered sapphire, lanthanum aluminate, magnesium oxide, and neodymium gallium oxide were all found to show the nanometer-scale particles (not to be confused with much larger particles commonly observed on laser-ablated YBCO thin films).

NIST APPLIES FOR PATENTS ON ADVANCED TEST STRUCTURES FOR NANOMETER-SCALE MEASUREMENTS

NIST scientists have applied for patents on two test structures having nanoscale capabilities. Test structures are special devices fabricated as an integral part of an integrated-circuit wafer (typically along with product devices) and widely used to measure various parameters associated with the fabrication process, including materials properties and dimensions. Instruments known as wafer probers make electrical contact with test structures through pads on the structures and conduct electric signals from measurement circuits in the probers to and from the structures. Test structures provide means for implementing the large number of measurements required for process control and diagnosis in modern integrated-circuit manufacturing.

The employment by the semiconductor industry of increasingly smaller feature sizes requires the development of test structures having capabilities to match.

The first patent covers a line-width micro-bridge test structure. This test structure uses four-terminal bridge resistance measurements to determine the width of a conducting line. An interference in this measurement traditionally has been the shunting effect of the voltage taps. The new test structure contains additional dummy voltage taps and allows the width to be extracted even when the active region of the bridge is short and the voltage taps are arbitrarily wide. The second patent covers a method and structure for eliminating the effects caused by imperfections in electrical test structures utilized in submicrometer feature metrology. This structure also uses four-terminal bridge resistance measurements, in this case employed to determine the separations of pairs of conducting features. By canceling errors caused by asymmetries in, and current shunting at, the voltage taps, the test structure permits feature placement to be determined to within 15 nm.

NIST RECOMMENDS NIJ RESTRICT COMPLIANCE TESTING OF POLICE BODY ARMOR TO LARGE SIZES

The NIST Office of Law Enforcement Standards (OLES) recently completed an experimental evaluation that resulted in a recommendation to the National Institute of Justice (NIJ) to restrict compliance testing of police body armor to physically large specimens, corresponding to shirt or jacket sizes of 46 to 48. NIJ has responded to the recommendation with a statement requesting large-size specimens, with provision for special exceptions in which the armor supplier formally accepts that no retests will be allowed on the basis of size. Body armor is claimed to have saved lives over 1300 times to date; thus its performance is a vital issue to police officers. Under the NIJ program of compliance testing, more than 800 models of body armor have been impacted by bullets under controlled conditions (including bullet type and size, bullet velocity, and pattern of bullet impacts) to determine if the armor models met the NIJ armor standard. In some instances, companies and police departments have submitted small-size specimens, and the law-enforcement community has become concerned that the ballistic test results could be influenced in some unknown way by the size of individual specimens or by minimally spaced shot patterns.

Accordingly, in consultation with NIST scientists, OLES designed and conducted a pilot experiment, with an intentionally limited number of specimens, to investigate these issues. The data obtained from the experiment were analyzed using a statistical model that allowed for estimation of the possible effects of three factors: armor size, the spacing of impact points, and the difference between front and back panels. None of these factors was found to have a statistically significant effect. Because the number of specimens was limited, confidence intervals for the estimated effects were wide, and it was not possible to rule out the existence of subtle, or even not-so-subtle, long-term effects. Calculations demonstrated that a very large experiment would be required to produce acceptably reliable estimates of any possible effects resulting from shot-pattern spacing and armor size. NIST concluded that the expense of such experiments would not be warranted and recommended that NIJ sanction compliance testing of only larger armor sizes.

VIDEOTAPE DEMONSTRATES NIST MODEL FOR SIMULATING FLAT-PANEL DISPLAYS

The NIST Digital Imaging Project has produced a videotape that demonstrates vividly what NIST has accomplished to date in the modeling of flat-panel displays. Among other applications, flat-panel displays are used widely in lap-top and notebook computers, are key elements of advanced aircraft cockpits and vehicle dashboards, are equally key elements in situational displays for both defense and civilian applications, and are beginning to appear as replacements for cathode-ray tubes in television sets and electronic instrumentation. Effective exploitation and improvement of flat-panel displays will depend on a better understanding of the mechanisms underlying their operation and an ability to characterize their performance. The videotape is intended to be used in support of discussions between representatives of the Digital Imaging Project and members of other laboratories in industry, government, and academia.

Having a running time of about 15 min, the tape opens by demonstrating the effect of viewing angle for an active-matrix liquid-crystal display as an introduction to the developmental NIST model for a display having pixels which modulate light by exploiting the electro-optical Kerr effect (not actually used for displays). The tape shows visually how such a display would work and the results of implementing the model on the NIST Princeton Engine

videocomputer to investigate the effects of viewing angle, cross talk between pixels, and resistance between the connections of the elements that form the screen. The Kerr-effect model was chosen for its mathematical and conceptual simplicity. However, since it exhibits artifacts generic to electro-optic displays, it serves as a prototype upon which more complicated and realistic models of liquid-crystal and other flat-panel display technologies can be based.

NIST/INDUSTRY CRADA

A major producer of heavy equipment has signed a CRADA with NIST to develop artifacts for the interim testing of coordinate measuring machines (CMMs). The private company will be participating in a program designed to create equipment and methodologies for the rapid assessment of CMM performance. The company's technology center in Peoria, IL, will be testing prototypes developed at NIST and assisting in developing factory floor versions of the technology.

NEW CRADA TARGETS KEY MACHINE FOR MAKING FUTURE CAR ENGINES

A new cooperative research project has been initiated between NIST, private Industry, and the National Center for Manufacturing Sciences to enhance the accuracy of one of the participating companies' piston turning machine. The machine produces high-precision pistons for today's automobile engines. Next-generation engines will require complex-shaped pistons that must meet dimensional tolerances much more stringent than those for today's simpler, slightly oval versions. Consequently, the machine accuracy has to be improved by about a factor of five.

NIST researchers have been working on machine-tool accuracy enhancement by real-time software error compensation for the last 10 years. With this cooperative research project, they will apply their expertise in the piston-turning machines which also require high-speed, high-precision actuation systems, another major research focus at NIST. The NIST researchers will evaluate the machine's performance over a range of operating conditions, characterize the thermal and geometric errors, and modify actuator design to improve the actuation system's speed by a factor of two.

CALIBRATION OF PROFILOMETER FOR GEOMETRIC CHARACTERIZATION OF ROCKWELL C HARDNESS INDENTERS

During the past fiscal year, staff members at NIST have evaluated alternative instruments for measuring the microform shape of Rockwell C indenters. A profilometer was procured for this purpose; and fixtures, artifacts, and procedures for instrument calibration have been developed. The calibration is based upon measurement of both circular arc and spherical form (400 μm diameter) and conical form for rotational symmetry about the indenter axis. The instrument calibration has required several unique manufacturing and assembly tasks to obtain calibrated artifacts representative of indenter geometry and form. Future work will focus upon measurement of working indenters to establish procedures and documentation requirements.

This work is one part of the National Hardness Standardization Program headed by NIST. Other aspects of the program include the development of Standard Reference Materials for hardness and the certification of hardness measuring machines.

NEW AMERICAN STANDARD FOR ROBOT PERFORMANCE

The American National Standards Institute has approved a new American standard for industrial robots and robot systems for "Path-Related and Dynamic Performance Characteristics Evaluation." This standard is intended to be used for the evaluation of the general dynamic performance of robots and, in particular, their ability to move their end effector on a continuous path.

This standard was developed by a committee consisting of members who came from the robot manufacturers industry, robot users, academia, and NIST. The main objective of the committee was to come up with a standard that is practical and can be used to facilitate comparisons of like robots, in order to make possible the easy selection of robots by users. This became a very important condition for the development of this standard since the robot users felt that relevant International Organization for Standardization (ISO) standards do not help them when it comes to the crucial decision of robot selection.

NIST played an important technical advisory role in the development of this standard. The NIST member pointed out to the committee that a relevant path-related performance characteristics evaluation standard, proposed by ISO, is not practical from a robot metrology point of view and cannot be

performed with currently available metrology equipment. A different approach to this evaluation standard was proposed to the committee. This approach was accepted and became the basis for the American standard.

CERTIFICATION OF CADMIUM AND LEAD IN ALUMINUM

Scientists at NIST have collaborated with the Aluminum Association and the primary aluminum manufacturers in the United States (under the auspices of the American Society for Testing and Materials) in the production of a series of aluminum Standard Reference Materials (SRMs). These standards are certified for cadmium and lead content.

Increased concern about toxic metals in the environment has resulted in legislation in 13 states and proposed legislation at the federal level. The legislation is aimed at eliminating cadmium and lead from packaging materials. Lead and cadmium can be introduced into these materials during certain recycling processes. The toxicity of these elements, coupled with the increased amount of recycled aluminum used today, has resulted in the need for these standards to provide an effective benchmark for the requisite chemical measurements.

Certification measurements were made at NIST using the highly accurate technique of isotope dilution mass spectrometry. Two alloy types (nominal Cd content 8, 20, and 50 parts per million and nominal Pb content 20, 60, and 150 parts per million) were analyzed. The Standard Reference Materials Program will issue these materials (SRMs 1710-1715) as solid disks.

WORKSHOP ON SUPERCRITICAL WATER OXIDATION

The proceedings of a recent Workshop on Federal Programs Involving Supercritical Water Oxidation, held in July 1992 at NIST in Gaithersburg, have been published in NISTIR 4920. The workshop, sponsored by NIST, brought together project leaders and program coordinators of federal efforts to use the process of supercritical water oxidation (SCWO) in the treatment of waste streams. Supercritical water oxidation has been described as a technology of high promise for safe and economical processing of a wide variety of environmentally dangerous waste streams.

Several military programs were discussed, including U.S. Army and Air Force programs for

demilitarization of weapons stockpiles and a DARPA program to develop a transportable 3800 L/d SCWO pilot plant for destruction of chemical agents, propellants, and other hazardous or toxic substances. U.S. Navy efforts to develop a pilot plant for treatment of shore-side industrial wastes and a compact shipboard waste-water treatment system also were described.

Other programs described included the use of SCWO by NASA for space life-support applications and a number of projects being developed by the Department of Energy involving SCWO treatment of mixed radioactive wastes and applications to site clean-up.

THIN-FILM THERMOCOUPLE RESPONSE DETERMINED TO 100 kHz

Thin-film thermocouple (TFTC) devices are ideally suited as probes of temperature and heat flux transients in the high-temperature, reactive environments characteristic of internal combustion and jet engines. There are several advantages to these devices. One is that the low physical profile of the devices makes them essentially nonintrusive. A second is that thin-film devices have the potential for high-speed response. A third advantage is that when fabricated of appropriate materials, these devices can maintain robustness to chemical, thermal, and mechanical stresses. However, because of their multilayered structure, the response of TFTC devices is very nonlinear with respect to the frequency of the heat flux. Therefore, the calibration of such a device must include validation of a model for the frequency-dependent response of the structure and determination of the material-dependent thermal parameters inherent to the model.

Scientists at NIST have developed a system based on pulsed and sinusoidally modulated laser heating which allows the measurement of TFTC gauges over a wide range of frequencies, from 0.01 Hz (i.e., essentially dc) to over 100 kHz. This system has been used to make measurements on a TFTC heat flux gauge employed in the development of a prototype ceramic-lined diesel engine. The gauge consists of a thin-film metal thermocouple (a 4 μm film consisting of Pt on Pt-10% Rh) sputter-deposited on a thick ceramic layer (1 mm zirconia) with low thermal conductivity which was deposited by the plasma spray technique on a metal engine plug (a semi-infinite heat sink). The thermal response of this device is accurately described by a heat-transfer model for over 7 decades

in frequency. Additionally, the scientists have determined thermal conductivities and diffusivities for the various layers and studied the sensitivity and the stability of the response as a function of temperature from 300 to 900 K.

LASER COOLING AND TRAPPING OF XENON

Laser-cooling metastable rare gas atoms such as xenon offers a number of unique opportunities. Laser-cooled metastable xenon has been identified as an ideal candidate for an optical frequency standard, with potentially unprecedented stability. In addition, such systems are interesting in numerous areas: ultra-cold collision physics, highly forbidden transition rate measurements, quantum collective effects, novel surface probes, and atom interferometry.

Researchers at NIST have succeeded in decelerating and magneto-optically trapping metastable xenon for the first time, using light from a single titanium:sapphire laser. Each of the nine stable isotopes has been trapped, including those with an abundance of less than 0.1 percent. The extremely high isotopic selectivity of the laser cooling and trapping has been used to improve greatly the accuracy of isotope shifts and hyperfine structure constants. Results also were obtained on collision processes that affect trap performance.

The primary loss mechanism out of the magneto-optical trap is a collision process known as Penning ionization, in which two metastable atoms collide and exchange excitation energy. If an atom receives enough energy to ionize, it leaves the trap. Preliminary measurements have shown a Penning ionization rate substantially less than that for lighter metastable rare gas atoms. The researchers have observed both Penning ionization from the metastable state and from the optically excited state used in the laser cooling. Experiments are under way to look for the predicted, but never observed, quantum statistical suppression of ionization in a spin-polarized sample of fermions.

CHARACTERIZATION OF A NEW CLASS OF COMPOUNDS BEING CONSIDERED FOR USE AS ALTERNATIVE REFRIGERANTS

The phasing out of the chlorofluorocarbons (CFCs) commonly used as refrigerants, solvents, and propellants for the last 50 years is causing the search for environmentally acceptable alternatives to be accelerated. One of the families of compounds that are being considered for use as

alternative refrigerants is a class of partially fluorinated ethers. In the search for new refrigerants, no one compound has been found to be satisfactory in all respects. Therefore, mixtures of various compounds are being considered. Mixtures offer the potential of tailoring refrigerants in a variety of ways: modifying vapor pressure, changing lubricant solubility characteristics, changing specific heat, and altering flammability ranges. However, the number of mixtures possible is so large that measurement of all possibilities is impractical. One must rely on a small number of wisely chosen measurements and combine these with the best theoretical modeling techniques to predict the necessary properties.

The properties of hydrocarbon and halogenated hydrocarbon mixtures have been found to have strong correlations with the permanent electric dipole moments and the molecular polarizabilities of the constituent compounds. The electric dipole moment has been used for predicting the mixture equation of state, a feature that has been incorporated into NIST Standard Reference Database 23, "NIST Refrigerant Properties Data Base." However, when a compound has the possibility of existing as several steric conformations (as is the case with the partially fluorinated ethers), dielectric measurements are insufficient to determine the dipole moments and relative abundances of the various conformers. Unique interpretation of the dielectric measurements is possible only if the dipole moments and the relative abundances of the various conformers present can be obtained independently.

To establish some benchmarks to aid these modeling calculations, NIST scientists studied two members of the family of fluorinated ethers in detail, namely $\text{CF}_2\text{HOCHF}_2\text{H}$ and $\text{CF}_2\text{HOCH}_2\text{CH}_3$, and determined the lowest energy conformation and measured the electric dipole moments of the lowest energy conformer for both compounds. This is important information for use in modeling the mixture equations of state for this series of compounds since each conformer makes an individual contribution, which is strongly dependent on the dipole moment, to the free energy of the mixture. With these additional data, obtained only from the high-resolution rotational spectrum, predicting the equations of state that treat these materials as a mixture of components will be more accurate than could be obtained from measurements of the average dipole moment.

UNCERTAINTY STANDARD ON RADIATION PROCESSING DOSIMETRY DEVELOPED

NIST scientists have made significant contributions to the development of a new draft E10.01 American Society for Testing and Materials (ASTM) standard on the statement of uncertainty in measurements of absorbed dose in industrial radiation processing. Dose measurements are required to assure that the dose delivered to the product meets the requirements of the process, whether for regulatory needs such as the sterility of medical products or food processing, or for materials' property modification such as polymer cross linking. It is critical that an appropriate statement of the uncertainty in these dose measurements be developed and made consistent with the terminology and basic concepts of ISO/TAG 4 Guide to the Expression of Uncertainty in Measurement. The ASTM document will be used as a model for other ASTM documentary standards relating to radiation dosimetry, will help them conform with accepted international guidelines, and will provide a uniform format for the statement of measurement uncertainties.

NVLAP ACCREDITS FIRST SECONDARY CALIBRATION LABORATORY FOR IONIZING RADIATION

The NIST National Voluntary Laboratory Accreditation Program (NVLAP), in coordination with the NIST Office of Radiation Measurements has accredited the first laboratory under the Secondary Calibration Laboratory for Ionizing Radiation LAP. The Food and Drug Administration's Center for Devices and Radiological Health (CDRH) has been accredited in accordance with NIST Special Publication 812, Criteria for the Operation of Federally Owned Secondary Calibration Laboratories for Ionizing Radiation, to perform calibrations of diagnostic, survey, and reference class instruments for the measurement of x-ray fields. Instruments calibrated by CDRH are used by state radiological inspectors to assure that diagnostic x-ray machines in all hospitals and doctors' offices are operated in a safe and effective manner.

NIST-7 REPLACES NBS-6 AS U.S. PRIMARY FREQUENCY STANDARD

NIST-7, an optically pumped cesium-beam frequency standard developed by NIST researchers,

has officially replaced NBS-6 as the U.S. primary frequency standard. The standard, designed to ultimately operate with an accuracy of 1×10^{-14} already is performing at a level of 4×10^{-14} . At this level it is two times more accurate than NBS-6. Further study of systematic effects will be needed to attain the design accuracy, and additional electronic development is needed to increase automation of its operation. The development of the standard was led by NIST scientists with input on the design from many other quarters. The design of the microwave system, for example, was done in large part by colleagues in Italy and invaluable design review was provided by colleagues in private industry.

This is the most accurate optically pumped standard to be used as a primary standard. All previous cesium standards have been based on magnetic-state selection and detection. One key advantage of the technique is greatly enhanced signal-to-noise performance, which allows for more rapid evaluation of accuracy. In fact, this standard has the best short-term performance of any cesium-beam standard ever built. When it achieves its full-design accuracy, it will be the most accurate primary frequency standard in the world.

“GIANT CATALYSTS”—A NEW GENERATION OF MESOPOROUS MATERIALS

A collaborative research effort has been initiated between scientists at NIST, the University of California (Santa Barbara), and private industry to characterize, by neutron scattering techniques, a new generation of “giant catalysts” containing mesopores. The discovery of this revolutionary new class of mesoporous materials was recently reported by industry (Nature, vol. 359, p. 710, 1992).

The new mesoporous molecular sieves are unique in that they contain hexagonally arranged and uniformly sized channels whose size can be varied in diameter within the range 1.3 to 20 nm by controlled density synthesis, and are up to an order of magnitude larger than previously existing zeolite catalysts which are at the heart of our chemical production petroleum industries. These new materials are being studied intensively for their potential in many applications, including large-molecule catalysis and chemical separation, as well as their possible role as hosts for semiconductors or “quantum wires,” which may be constructed by chemical reactions in the channels. NIST has a unique collection of neutron research facilities for studying the processing, structure, and molecular behavior of these exciting new materials.

STRESSES IN CERAMICS MEASURED BY RAMAN SPECTROSCOPY

Residual stresses due to processing, phase transformations, etc., are a significant factor in the reliability of ceramics used in both structural and electronic applications. Microfocus Raman spectroscopy, which can have a lateral resolution on the order of a micrometer, is an ideal tool for residual stress measurements, since these stresses frequently vary dramatically over distances comparable to the size of the microstructure. A diamond pressure cell and an *in situ* biaxial stress apparatus have been used to obtain calibration curves of stress vs. Raman peak position for polycrystalline alumina in a microfocus Raman spectrometer. The diamond pressure cell provides a curve relating peak shift to hydrostatic stress while the biaxial apparatus provides a similar curve for directionally applied stresses. Such calibration curves are essential for quantitative measurements of residual stresses using Raman peak shifts. This methodology now is being used at NIST to evaluate residual and applied stresses in monolithic and composite ceramics.

TEMPERATURE SENSING IN ALUMINUM PROCESSING

A significant step in the development of a non-contact electromagnetic temperature sensing system for on-line monitoring of high-speed rolling of aluminum sheet has been accomplished in a test performed at an industrial research center. The demonstration was carried out under a cooperative research and development program shared by NIST and The Aluminum Association, Inc., a consortium of processing and manufacturing companies. The electromagnetic sensing system operates by measuring the induction of eddy currents in the moving test material and thereby obtaining the electrical resistivity which depends upon the temperature in a known way. The results of the electromagnetic (or eddy current) measurements were compared with readings from a thermocouple which contacted the moving material. The test demonstrated that one can compensate for variations in the electrical resistivity of the test material arising from variations in alloy composition.

GAS-COUPLED ACOUSTIC MICROSCOPE

The feasibility of a new gas-coupled acoustic microscope has been demonstrated by NIST scientists. Traditionally, acoustic microscopy relied on liquid couplants, which impose several operational

restrictions in high-speed quality-control applications. The new microscope functions in both through-transmission and pulse-echo modes, and appears to exhibit better spatial resolution characteristics than similar liquid-coupled devices. Images have been obtained in the 3 to 20 MHz frequency region. Potential applications include quality control in the microelectronics industry and materials characterization.

ADVANCED SMARTCARD DEVELOPED

NIST scientists have developed an Advanced Smartcard Access Control System (ASACS), which implements the proposed Digital Signature Standard on a device with the same dimensions as a standard credit card. Easily carried in a wallet or purse, the smartcard provides users with a secure means for generating and verifying digital signatures. Digital signature technology, which provides a replacement for the handwritten signature, is a crucial element in the processing of electronic documents. The smartcard also contains the Data Encryption Standard algorithm and supports unitary log-in authentication using cryptographic techniques. Several federal agencies are initiating programs which will take advantage of the technology developed for the ASACS project.

NIST AND INDUSTRY JOIN FORCES IN PARALLEL PROCESSING RESEARCH

NIST successfully fabricated its MultiKron very large scale integration (VLSI) instrumentation chip and transferred the technology to private industry for its supercomputer parallel system. NISTIR 4737, Operating Principles of MultiKron Performance Instrumentation for Multiple-Instruction Multiple-Data (MIMD) Computers, describes the single-chip VLSI design, which replaces earlier performance instrumentation chip sets. In addition, researchers redesigned and refabricated a faster MultiKron version in a smaller-sized VLSI reticle, resulting in reduced costs. Also designed and implemented was a prototype of a local collection network for captured performance data.

GUIDELINES FOR EVALUATING VIRTUAL TERMINAL IMPLEMENTATIONS PUBLISHED

NIST Special Publication 500-205, Guidelines for the Evaluation of Virtual Terminal Implementations, assists users in determining which implementation, among several candidates, best meets their

functional requirements. The document is one of a series of evaluation guidelines for Open Systems Interconnection (OSI) applications. NIST has issued guidance for message handling systems and file transfer, access and management implementations and plans evaluation guidelines for other OSI applications, such as directory services. These documents help users implement Federal Information Processing Standard 146-1, Government Open Systems Interconnection Profile, which facilitates the interoperability of dissimilar computer systems in the federal government.

NIST ISSUES STUDY OF OPEN SYSTEMS INTERCONNECTION (OSI) KEY MANAGEMENT

For communications between computer systems to be useful in many environments, the systems and their communications must be secure. One prerequisite is the management of keying material needed by the underlying cryptographic mechanisms that provide security. NISTIR 4972, A Study of OSI Key Management, addresses key management as it applies to communications protocols based on the OSI architecture. The report contains criteria and a model of OSI key management incorporating both secret key and public key cryptography. A guest researcher at NIST authored the study.

GUIDANCE ON COMPUTER SECURITY TOOLS AND TECHNIQUES PUBLISHED

Two new NIST publications assist users in the selection of appropriate tools and techniques for protecting computer systems and the information they process. NIST Special Publication 800-5, A Guide to the Selection of Anti-Virus Tools and Techniques, provides criteria for judging the functionality, practicality, and convenience of anti-virus tools. NIST Special Publication 800-6, Automated Tools for Testing Computer System Vulnerability, analyzes factors affecting the security of a computer system. Using automated tools, a system manager can identify common vulnerabilities stemming from administrative errors and take corrective action to reduce significantly the security exposure of their system.

Standard Reference Materials

STANDARD REFERENCE MATERIALS 1400 AND 1486—BONE ASH AND BONE MEAL

Research that relates human and animal nutrition to a number of diseases often depends on linking nutritional intake of minerals with the concentration of those same minerals in bone. The bone matrix presents a severe challenge to analytical methodology in the decomposition of samples prior to atomic spectrometric and other analyses. It is, therefore, helpful to have SRMs available in which the concentration of minerals in a bone matrix have been certified.

The Standard Reference Materials Program announces the availability of SRM 1400, Bone Ash, and SRM 1486, Bone Meal, to meet this research need. Certified values are given for Ca, Mg, P, Fe, K, Sr, and Zn in the two materials. Additionally, information values are provided for Al, As, Cd, Cu, Fe, Mn, Se, Si, Na, and C (total). The SRMs are issued in units of 50 g and are composed of powdered material.

STANDARD REFERENCE MATERIALS 3171A, 3172A, AND 3179—MULTIELEMENT SPECTROMETRIC SOLUTION MIXES

The U.S. EPA and state regulatory bodies have been monitoring a number of toxic metals in the environment under the Resource Conservation and Reclamation Act and the Solid Waste Program, among others. Most laboratories performing the needed analyses through the Contract Laboratory Program are using spectrometric techniques such as flame atomic absorption, inductively coupled plasma atomic emission, and inductively coupled plasma mass spectrometry for the analyses. These methods require the use of instrumental calibration solutions and interference check solutions.

The Standard Reference Materials Program announces the availability of three multielement solutions to meet these requirements, in addition to the full 3100 series of single-element calibration solutions. The multielement solutions SRM 3171a and 3172a are renewals of earlier SRMs to which antimony, molybdenum, thallium, and vanadium have been added. With these additions, the two solutions now contain all toxic metals important to Toxicity Characteristic Leaching Protocol (TCLP) and other environmental analyses. Most elements in these SRMs occur in ratios between 1:1 and

1:10, which are typical of natural waters, but not of solid environmental sample leachates.

SRM 3179 is a set of three solutions to be combined on dilution to provide not only the TCLP toxic metals, but also matrix elements (e.g., Al, Fe, and others), in ratios which are more characteristic of solid sample leachates prepared using the EPA Method 3050 leaching protocol.

SRMs 3171a and 3172a are issued in units of 50 mL. SRM 3179 is a set of three 50 mL solutions to be combined on dilution into a single multielement mix. Chemical incompatibilities of some elements preclude premixing as a single solution by NIST. All three SRMs are prepared in 5 percent (V/V) nitric acid.

STANDARD REFERENCE MATERIALS

2108-2109—CHROMIUM (III) AND

CHROMIUM (VI) SPECIATION SOLUTIONS

Chromium is a metal that occurs in the environment in both dissolved and solid phases and in a variety of chemical forms. It is the concentration of individual chromium species in a sample, rather than total chromium concentration, which is most useful in determining biological availability, toxicity, or potential as a nutrient. Therefore, reference samples having species-specific, certified concentrations are needed for calibration and to assure interlaboratory comparability of data in studies on the beneficial and/or harmful effects of chromium in the biosphere.

The Standard Reference Materials Program announces the availability of SRMs 2108 and 2109 to meet these needs. SRM 2108 is a solution containing 1.000 mg/mL of chromium only in the plus-three oxidation state. It was prepared by the dissolution of high-purity metal in hydrochloric acid. The absence of chromium plus-six was established spectrophotometrically.

SRM 2109 is a solution containing 1.000 mg/mL of chromium only in the plus-six oxidation state, prepared by the dissolution of high-purity potassium dichromate (SRM 136e) in deionized water. The absence of chromium plus-three in SRM 2109 was measured by an ion-exchange separation of the two states, and measurement of total chromium in the eluent, which would indicate chromium plus-three, if present. The two SRMs are issued in units of 50 mL each.