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News Briefs

General Developments

Inquiries about News Briefs, where no contact person is identified, should be referred to the Managing Editor, Journal of Research, National Institute of Standards and Technology, Administration Building, A635, Gaithersburg, MD 20899; telephone: 301/975-3572.

FUTURISTIC CRANE NOW READY FOR APPLICATIONS

Strong, agile, and a jack-of-all-trades when equipped with the right tools, a novel robot crane developed at NIST is ready to be put to work—on Earth or even another planet. Unlike standard cranes, the NIST device can lift more than five times its weight and precisely maneuver loads over a large working volume. Suspended by six cables from the center of its octahedral frame, the crane's triangular platform moves about six axes. It rigidly retains its position, even when tilted at angles. As a result, loads are remarkably stable. The crane features a "Stewart platform," named for the English engineer whose 1965 design of a mechanical platform has served as the basis for the aircraft simulator. Researchers envision many applications for the versatile technology—conventional construction, deep-sea drilling, cleanup of toxic and radioactive waste sites, and even extraterrestrial exploration and construction. Several mobile and stationary prototypes have been built to demonstrate the crane technology's capabilities to potential users. For more information, contact James Albus, B124 Metrology Building, NIST, Gaithersburg, MD 20899, 301/975-3418.

PATENTED STM TIP YIELDS HIGHEST RESOLUTION EVER

NIST recently received a patent for the "highest resolution" probe end ever developed for a scanning tunneling microscope (STM), a device that soon may be used for atomic-scale manufacturing of semiconductor devices and computer memory elements. Structures now routinely produced by optical lithography (writing fine lines or spots with light) have dimensions of hundreds of nanometers. The STM would permit lithography at the 10 nm and, eventually, the single-atom level. This would be done by chemical vapor deposition (CVD), a process where a beam of low-energy electrons stimulates molecules from a surrounding gas to etch or deposit on the desired surface. Current STM probes placed close enough to the surface to generate a sufficiently localized electron beam leave little space for CVD molecules to diffuse through the gap between the probe and surface. Moving the probe back spreads the beam over a larger region, reducing the resolution. The NIST-designed probe end produces a much sharper electron beam spot on the surface, with the probe far enough away for the CVD molecules to move under it. This allows precise control—essentially single-atom positioning—of reactions with the surface. For more information, contact Alan Gallagher, Div. 848, NIST, Boulder, CO 80303, 303/492-7841.

CRYOGENIC PROPERTIES OF COPPER, ALLOYS DESCRIBED

The mechanical, thermal, and electromagnetic properties of selected coppers and copper alloys at cryogenic temperatures are compiled, reviewed, and analyzed in a new NIST monograph. The metals and alloys described are oxygen-free coppers (C10100-C10700), beryllium coppers (C17000-C17510), and phosphor bronzes (C50500-C52400, which includes many copper-tin alloys). Properties are tabulated for a temperature range from 4 to 295 K. These include tensile strength, fatigue, and creep data; elastic constants; specific heat; thermal conductivity and expansion; and electrical resistivity. The work was sponsored by

the International Copper Association, Ltd. Monograph 177, Properties of Copper and Copper Alloys, is available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402-9325, 202/783-3238. Order by number 003-003-03140-2 for $32 prepaid.

SHRINKING PART TOLERANCES ADDRESSED BY NEW REPORT

Meeting the increasingly stringent measurement needs of U.S. industry is the subject of a new NIST report, Challenges to NIST in Dimensional Metrology: The Impact of Tightening Tolerances in the Discrete-Part Manufacturing Industry (NISTIR 4757). The report states that tolerances in the shape, size, and fit of manufactured parts are shrinking dramatically. For example, in machining parts for a car door, a variation of 7.5 μm in machine-tool accuracy was acceptable in 1980. By the year 2000, that tolerance will diminish to 1 μm (about 1/70th of a human hair). To inspect parts and the precision of the fit between them, companies use measurement tools that are 4 to 10 times more accurate than their production machines. Therefore, the report says NIST must achieve accuracies that are 4 to 10 times better than the industry's inspection-measurement systems to provide needed calibrations and other services. Single copies of NISTIR 4757 are available free of charge from Christie Poffenbarger, A109 Metrology Building, NIST, Gaithersburg, MD 20899, 301/975-3463.

SUMMERTIME STRETCHED FOR AN EXTRA SECOND

Americans savored a little more summer in June when the world's timekeepers gave us an extra second. At precisely 23 hours, 59 minutes, 60 seconds UTC (Coordinated Universal Time) or 7:59:60 p.m. EDT on June 30, 1992, one second was added to the world's time in order to keep super-accurate atomic clocks in step with the Earth's rotation. In the United States, this correction was made in atomic timekeeping systems at NIST in Boulder, CO, and the U.S. Naval Observatory in Washington, DC. It marked the 17th "leap second" that has been inserted into atomic clocks since 1972. Usually, the seconds are added on December 31; the last time a second was inserted on June 30 was in 1985. The correction is needed because the Earth is a poor "clock" compared with modern atomic clocks. The Earth's rotation is only constant to about one-thousandth of a second per day, while atomic clocks have an accuracy of one-billionth of a second per day.

GARNET FILM EXCELS AS MAGNETIC FIELD SENSOR

Collaborative efforts between NIST and an industrial laboratory have shown that certain iron garnet films may be the most sensitive nonelectrical devices for wideband radio-frequency (RF) magnetic field measurements. The films possess a Faraday effect (where a magnetic field causes a rotation of the plane of polarized light transmitted through the films) response at much higher frequencies than anticipated: as high as 1 GHz. The magnitude of the effect appears to be adjustable by varying the kind and amount of certain ions (for example, gallium or bismuth) introduced into the pure yttrium-iron-garnet films. These features, together with compatibility with optical fiber technology, make the films good candidates for constructing compact, sensitive magnetic field sensors. A paper describing the work was published in the April 27, 1992, issue of Applied Physics Letters. For reprints of paper 27-92, contact Jo Emery, Div. 104, NIST, Boulder, CO 80303, (303) 497-3237.

LAB ACCREDITATION PROGRAMS GUIDE AVAILABLE

The Directory of Professional/Trade Organization Laboratory Accreditation/Designation Programs (NIST SP 831) is designed to help officials in commerce, industry and government locate private sector laboratory accreditation and similar programs for the testing of products and services. The guide lists 48 private-sector organizations that accredit or designate more than 9000 labs and other entities to assist professional societies, trade associations and related certification bodies in carrying out their responsibilities. Fields of test include acoustical and vibrational, biological, chemical, construction materials, electrical, geotechnical, mechanical, medical, metrology, non-destructive, optics and photometry, and thermal. Copies of SP 831 are available for $7.50 prepaid from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402-9325, (202) 783-3238. Order by stock no. 003-003-03144-5.

GATT STANDARDS ACTIVITIES REPORTED FOR 1991

The NIST Standards Code and Information (SCI) Program assists U.S. industry in trade and related problems through distribution of notifications on proposed foreign regulations that might affect U.S. trade. The annual report, GATT Standards Code Activities of the National Institute of Standards and Technology 1991 (NISTIR 4829), describes NIST's

role in operating the U.S. inquiry point for standards and certification information in support of the General Agreement on Tariffs and Trade (GATT) Standards Code. SCI responds to information requests on proposed foreign regulations issued through the GATT in Geneva, Switzerland, coordinates comments on these regulations, arranges for translations, and operates a GATT information hotline at (301) 975-4041. SCI also operates a European Community (EC) hotline, (301) 921-4164, with information on draft EC documents. Regulations on medical devices, terminal equipment, accreditation systems, chemicals, and timber/lumber were most often requested in 1991. To obtain the report, send a self-addressed mailing label to SCI, A163 Building 411, NIST, Gaithersburg, MD 20899, (301) 975-4037.

REPORT EXAMINES HOW MEASURING DEVICES AFFECT FLOW

Orifice plate flowmeters are among the most common flow measuring devices used in the natural gas and chemical processing industries. With billions of dollars in revenue dependent on accurate flow metering, the Gas Research Institute has sponsored a number of NIST studies evaluating different aspects of orifice plate measurement techniques. The most recently published study determined that certain types of flow conditioners provide better flow measurement by the orifice plate, that there is an optimal range of distances for positioning the flow conditioner from the plate, and that the orientation of the plate's pressure taps affects measurement accuracy. The report, The Effects of Flow Conditioners and Tap Location on Orifice Flowmeter Performance (NIST TN 1352), is available for $4 prepaid from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402-9325, (202) 783-3238. Order by stock no. 003-003-03150-0.

GUIDE ADDRESSES SECURITY IN FEDERAL PROCUREMENT

Today's computer security threats—viruses, white-collar crime, hardware/software theft or unauthorized data access—make security vigilance more important than ever. Computer security is less costly and more effective, a new NIST report says, when it is included in the acquisition stage of a system. The report gives federal contracting officers and others a summary of how to incorporate security into procurement. The guide is split into three sections: defining computer security and the procurement process, integrating security into acquisitions, and selecting computer security features and assurances. Computer Security Considerations in Federal Procurement (NIST SP 800-4) is available for $6 prepaid from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402-9325, (202) 783-3238. Order by stock no. 003-003-03147-0.

NIST, RUSSIAN SCIENTISTS PUT "FOCUS" ON COLD NEUTRONS

For the first time, U.S. and Russian scientists have successfully focused a beam of cold neutrons onto a spot slightly smaller than the letter "o" in the word "neutron" (mm^2). Scientists from NIST, the State University of New York at Albany, and the I.V. Kurchatov Institute of Atomic Energy, Moscow, described this accomplishment in the June 4, 1992, issue of Nature. The work was done at NIST's Cold Neutron Research Facility. Scientists use cold neutrons to detect chemical elements in advanced materials, such as semiconductors and aerospace alloys. The NIST researchers plan to use focused cold neutron beams as probes to create detailed three-dimensional maps of elements used in microelectronic devices. Just as cold neutrons allow detection of chemical elements better than thermal neutrons, a focused beam of cold neutrons results in a higher spatial resolution than an unfocused beam. Focusing is accomplished by having a glass fiber lens guide the neutrons to a small focal point. Each fiber contains more than 1000 hollow capillaries.

"HOW-TO" GUIDES AVAILABLE FOR SHOP AUTOMATION

Machine shops and other small manufacturers can learn about assessing equipment needs, evaluating computer-aided design programs and implementing new automated technology from three new publications from NIST's "Shop of the 90s." The guides are In-House Machine Tool Evaluation (NISTIR 4772), An Evaluation Tool for Wireframe CAD Software (NISTIR 4813), and Implementation of a CAD/CAM System for Small Machine Shops (NISTIR 4810). Advice and information presented are based on experience gained during modernization of the NIST machine shop and field work with a private company. Also available is a summary (NISTIR 4786) of the first 3 years of "Shop of the 90s" programs helping the nation's 125000 small job shops automate with existing, affordable technology. While supplies last, single copies of the guides and project summary are available at no charge by

writing the Shop of the 90s, Room 136, Shops Building, NIST, Gaithersburg, MD 20899. Multiple copies are available from the National Technical Information Service, Springfield, VA 22161, (800) 553-6847. Order NISTIR 4772 by number PB 92-164664, NISTIR 4813 by number PB 92-18113, NISTIR 4810 by number PB 92-181098, and NISTIR 4786 by number PB 92-172774.

RF/MICROWAVE MEASUREMENTS SUBJECTS OF PAPER

Electrical engineers will be interested in a new paper updating the current status of precision radio frequency (RF) and microwave measurements. It summarizes the principles and present status of microwave measurements in scattering parameters, noise and power. Topics covered include calibration methods for automatic network analyzers, on-wafer MMIC (monolithic microwave integrated circuit) measurements, microcalorimeters and other methods of high-accuracy measurements for power, and various radiometric techniques for noise measurements. The paper contains an extensive bibliography for those wishing information in more depth. For a copy of the paper, which was published in a special issue of Metrologia (May 1992) prepared for the 1992 Conference on Precision Electromagnetic Measurements held June 9–12 in Paris, France, contact Jo Emery, Div. 104, NIST, Boulder, CO 80303, (303) 497-3237. Ask for paper number 25-92.

NEW CHAMBER DEVELOPED FOR EMC TESTING

NIST is developing a new chamber for testing electromagnetic compatibility, vulnerability or shielding effectiveness that combines the transverse electromagnetic (TEM) cell with the mode-stirred chamber. The frequency range of testing is from 10 kHz to 18 GHz. The facility consists of an asymmetric TEM cell (1.01 m by 1.20 m by 2.98 m) with two cavity mode tuners, configured as a TEM transmission line-driven, mode-stirred chamber. Taken separately, the TEM cell and mode-stirred chamber have certain limitations in frequency; the TEM cell is limited to frequencies below a few hundred megahertz while the mode-stirred chamber is restricted to frequencies above this level. By developing a single facility, the testing can be done over the combined frequency ranges, saving both time and money. A paper discussing the facility's design, advantages and limitations for use, and the theoretical basis for its operation is available from Jo Emery, Div. 104, NIST, Boulder, CO 80303, (303) 497-3237. Ask for paper 21-92.

NEW INSTRUMENT MEASURES HIGH TEMPERATURES AT HIGH SPEED

A new NIST high-speed pyrometer (an instrument for measuring extreme heat) is available for researchers and engineers needing quick and accurate readings of very high temperatures. The portable pyrometer can measure temperatures between 1500 and 4000 °C at a rate of 10000 times per second with an accuracy of plus or minus 5 °C to 15 °C. It works by gauging infrared and visible radiance or brightness from a hot sample at six wavelengths with silicon photodiodes. No existing high-temperature pyrometer can measure temperature at as many wavelengths with the same accuracy and speed as the new NIST device. Although NIST scientists developed the pyrometer to study thermophysical properties of high-technology materials, the instrument also shows potential for industrial applications.

1992 WEIGHTS AND MEASURES LABS DIRECTORY PUBLISHED

State Weights and Measures Laboratories: State Standards Program Description and Directory, 1992 Edition (NIST SP 791) is a guide to help manufacturers and industrialists locate and obtain measurement services required by contract or law. The directory lists state and other labs certified by NIST. To be certified in an area, each state must have a trained metrologist, an adequate facility and demonstrate on a continuing basis that the lab is capable of providing valid measurements. Certification by NIST indicates the lab is capable of providing a measurement service, but each state is responsible for verifying its measurement traceability. For each state or certified lab, the directory lists the certification period, if certified by NIST; staff members, address and telephone/fax number; services available; fees for services; new proposed programs for grain moisture testing and petroleum quality testing; and the National Type Evaluation Program. Copies of SP 791 are available for $6.50 prepaid from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402, (202) 783-3238. Order by stock number 003-003-03145-3.

ISO 9000 PUBLICATION ONLY AVAILABLE THROUGH NTIS

Because of an overwhelming demand for NISTIR 4721, Questions and Answers on Quality, The ISO 9000 Standard Series, Quality System Registration, and Related Issues, NIST's supply of this publication has been exhausted. The report, first

announced in February 1992, briefly describes the contents of the ISO 9000 standards that were published in 1987 by the International Organization for Standardization (ISO) in Geneva, Switzerland. Copies of the report may still be obtained from the National Technical Information Service, Springfield, VA 22161, (800) 553-6847, for $9 (print) and $17 (microfiche) prepaid. Order by number PB 92-126465. NISTIR 4721 is not subject to copyright restrictions and may be copied or reprinted in its entirety.

COMMENT PERIOD EXTENDED AGAIN FOR CASE PROGRAM

In response to public requests, NIST is extending the deadline for public comments on the proposed conformity assessment systems evaluation (CASE) program. The voluntary program is intended as a mechanism to provide federal assurances to the Commission of the European Communities and other governments of the competency of qualified U.S. conformity assessment activities related to laboratory testing, product certification, and quality systems registration. The program was originally published for comments on March 26, 1992. Written remarks about the proposed CASE program must be submitted by Sept. 30, 1992. Comments and requests for information should be sent to Stanley I. Warshaw, Director, Office of Standards Services, A306 Administration Building, NIST, Gaithersburg, MD 20899, (301) 975-4000, fax: (301) 963-2871.

"RECIPE" FOR STANDARD DIPOLE ANTENNA AVAILABLE

Companies and laboratories testing products for electromagnetic (EM) compatibility will be interested in a new publication that describes and diagrams a spherical dipole radio-frequency antenna designed by NIST researchers as a standard EM source. The antenna effectively determines the accuracy of measurement systems used to quantify unintentional EM emissions from a variety of electronic products and devices. The publication, Standard Spherical Dipole Source (NIST TN 1351), describes the theoretical basis and the design considerations of the NIST antenna. It contains circuit descriptions and construction details, including numerous circuit diagrams. TN 1351 is available for $26 (print) and $12.50 (microfiche) prepaid from the National Technical Information Service, Springfield, VA 22161, (800) 553-6847. Order by number PB 92-187020.

REPORT EXPLORES SECURITY POLICY FOR NREN

The planned National Research and Education Network (NREN) promises to link scientists and educators to an immense "superhighway" of information. Available at a keyboard stroke will be services such as specialized software, file systems, supercomputer access and databases. But hurdles exist. The science community is accustomed to accessing information resources without restriction, and needs reliable services, accurate data and, above all, secure communications. However, a formal policy for NREN security is needed to ensure these conditions, says a new NIST report. The NIST author explains how the NREN is evolving and explores foundations for setting up a security policy acceptable to diverse NREN users. The policy proposed is intended to prompt further discussion and additional NREN development. Foundations of a Security Policy for Use of the National Research and Education Network (NISTIR 4734) is available for $19 (print) or $9 (microfiche) prepaid from the National Technical Information Service, Springfield, VA 22161, (800) 553-6847. Order by number PB 92-172030.

1992 ANNUAL DIRECTORY OF ACCREDITED LABS AVAILABLE

U.S. manufacturers, exporters, construction engineers, building owners, users of computers and telecommunications equipment, and procurement and regulatory officials will be interested in the 1992 Directory of Accredited Laboratories (NIST SP 810), which lists approximately 1000 domestic and foreign laboratories that are accredited by the NIST National Voluntary Laboratory Accreditation Program (NVLAP) for specific test methods as of April 1, 1992. The current fields of testing are acoustical, asbestos fiber analysis, carpet, commercial products (paint, paper, plastics, plumbing, and seals and sealants), computer applications, construction materials, electromagnetic compatibility and telecommunications, ionizing radiation dosimetry, solid fuel room heaters, and thermal insulation. The labs are listed alphabetically, by field of testing and by state. Send a self-addressed mailing label to: NVLAP, Room A162, Building 411, NIST, Gaithersburg, MD 20899, (301) 975-4016, fax: (301) 926-2884.

WORKSHOP TO EXAMINE NEW MIXED-SIGNAL TEST STRATEGY

For many electronic components and instruments, it is not physically or economically feasible to undertake exhaustive testing of all possible performance parameters. Previous efforts to develop shortened test regimens have shown varied results. However, a new NIST technique shows much promise as an abbreviated method that provides both economy and accuracy in mixed-signal device testing. NIST will examine these testing strategies, already being implemented in production line tests of integrated circuits, at a workshop Dec. 1–3, 1992, in Gaithersburg, MD. The workshop is intended for engineers, calibration lab managers and others interested in improving test efficiency for analog or mixed-signal products. The workshop will introduce a small set of practical mathematical tools, emphasizing implementation using commercial software rather than mathematical development. Cost of the three-day workshop is $750. For more information, contact T. Michael Souders, B162 Metrology Building, NIST, Gaithersburg, MD 20899, (301) 975-2406, fax: (301) 926-3972.

PAPERS AVAILABLE ON TRAPPED IONS AND LASER COOLING

A new collection of papers from the ion storage group at NIST highlights some of the world's most advanced research on laser cooling and atomic ion storage. The latest publication is the third compilation of the group's papers, covering the period from October 1988 to February 1992. Papers are arranged according to topics, including laser cooling, spectroscopy and frequency standards, fundamental tests of theory, non-neutral plasma studies and general articles. To obtain a copy of Trapped Ions and Laser Cooling III (NIST TN 1353), contact the National Technical Information Service, Springfield, VA 22161, (800) 553-6847. Order by number PB 92-189547; price is $35 (print) and $17 (microfiche) prepaid.

NEW NIST SPECTROSCOPIC ELLIPSOMETER USED IN DEMONSTRATION OF REAL-TIME CHARACTERIZATION OF NATIVE OXIDE GROWTH ON GaAs

NIST has put into operation a new spectroscopic ellipsometer and demonstrated its use in monitoring thin-film growth with a sensitivity of less than one atomic layer (monolayer). An NRC/NIST postdoctoral research associate has led the effort to construct and demonstrate the performance of the new ellipsometer, which is dedicated to spectroscopic measurements with a monochromator as light source (actually from near infrared to ultraviolet).

The instrument provides goniometer resolution of a few millidegrees and is intended primarily for the analysis of semiconductor materials and structures. In contrast with traditional single-wavelength ellipsometry, spectroscopic ellipsometry (SE) provides more information and allows a simultaneous determination of film thicknesses and their optical dielectric functions as well as a critical assessment of the models describing the optical response of semiconductors. Parameters of interest include thin-film densities, compositions, interface quality, and surface roughness. NIST scientists used the new ellipsometer to study the growth of the native oxide on gallium arsenide for a 3 day period while its thickness increased logarithmically in time from 0.4 to 1.4 nm. The results showed that SE can be an important in-situ tool for real-time characterization of thin-film growth and, therefore, is expected to contribute significantly to improved understanding of the surface chemistry involved, as well as providing data that can be used as a basis for controlling composition during growth. SE offers advantages compared with other in-situ surface probes in that it is noninvasive and can be used in any transparent ambient and at any practical temperature.

JOINT NIST/INDUSTRY PROJECT TO DEVELOP TECHNOLOGY, DIAGNOSTICS FOR THERMAL EMITTER ARRAYS

NIST and private industry have entered into a Cooperative Research and Development Agreement to develop two-dimensional arrays of thermal emitters, or sources of infrared radiation. The work will utilize micromachining and commercial semiconductor (complementary metal oxide-semiconductor) technologies and includes exploration of various array architectures, the establishment of array design guidelines for commercial exploitation, and the determination of array dynamic radiometric performance. As low-cost thermal targets, thermal emitter arrays offer means for field evaluation of infrared sensors and focal-plane arrays.

The work will combine expertise and capabilities of the two organizations in design, fabrication, and evaluation. The assignments are flexible. NIST will design arrays and have them fabricated, review selected array designs, and provide consultation on design and fabrication. The private company will develop and apply non-electrical means for evaluating arrays, including radiometric testing. Both

organizations may carry out micromachining and electrical tests; each may provide specimens of devices to the other for testing. The first project will involve a 16-by-16 array of emitters.

SPECIAL ISSUE OF SOLID-STATE ELECTRONICS FEATURES FOUR PAPERS FROM NIST

The March issue of Solid-State Electronics is a special issue on solid-state device and material measurements and includes four papers by NIST scientists.

The first paper compares five methods of measuring trap density at $Si-SiO_2$ interfaces and shows that when sources of error and limitations are taken into account, the methods are capable of yielding interface trap density estimates that are in good quantitative agreement. The second paper discusses the measurement of temperature coefficient of resistance (TCR) of metallization and the importance of TCR for measuring metallization temperature during electromigration accelerated stress tests. The third paper describes a method for high spatial resolution mapping of resistivity variations in semiconductors using an automatic probe station and lithographically defined contacts. The fourth paper discusses the measurement of feature placement on a semiconductor wafer using various test structure designs with a modeled accuracy of better than 10 nm.

EPITAXIAL GROWTH OF TIN OXIDE FILMS ON SAPPHIRE

NIST researchers have used reactive sputter deposition to grow the first highly ordered tin oxide (SnO_2) on crystalline sapphire substrates. Tin oxide is the base material used in many solid state gas sensors. The work was performed in a recently developed, ultrahigh vacuum system designed for depositing, modifying, and characterizing novel thin-film structures. Photoemission and diffraction results indicate that the 20-200 nm films are stoichio-metric and crystalline, and they are aligned with the atoms of the sapphire substrates. These results are especially interesting due to the different crystal structures of SnO_2 (rutile) and sapphire (corundum). Atomic force microscopy performed through a collaboration with researchers at the University of Maine has been used to study the surface morphology of the films and shows that they have a surface roughness of only 0.3 nm over an area of 4 μm^2. The results could lead to the development of new solid-state sensing elements with superior response characteristics. The production of epitaxial SnO_2 on sapphire is particularly important since sapphire wafers (already widely used for silicon-on-sapphire technology) should not interfere, chemically or electronically, with the operation of planar SnO_2 sensor devices. These findings also may find application in other technologies that use semiconducting oxide films.

PHOTOINITIATED OZONE-WATER REACTION

The first in a series of studies designed to unravel the dynamics of gas phase oxygen atom reactions has been completed by NIST scientists. Chemists long have believed that electronically excited oxygen reacts by inserting itself in a chemical bond involving hydrogen, while ground state oxygen reacts by abstracting hydrogen atoms. The chemical products of both mechanisms are OH (hydroxyl) radicals, but the product internal and translational energies are expected to vary with the mechanism.

These studies use 266 nm ultraviolet laser radiation to dissociate ozone molecules, forming electronically excited oxygen atoms, in exactly the same process that sunlight causes in the stratosphere. In the laboratory experiments, electronically excited oxygen atoms then react with isotopically substituted $H_2{}^{18}O$: $^{16}O + H_2{}^{18}O \rightarrow {}^{16}OH + {}^{18}OH$. Lasers are used to determine the internal state and kinetic energy distributions in the isotopically distinguishable fragments. Knowledge of these distributions is important to scientists using lasers to monitor OH concentrations in the atmosphere.

In contrast to expectations that energy should be shared equally between products formed when oxygen atoms insert into chemical bonds, these experiments show that the ^{16}OH newly formed in the reaction carries substantially more of the vibrational, rotational, and translational energy produced in the reaction than the residual ^{18}OH. The results reveal that the reaction proceeds promptly, with significant scattering anisotropy in the center of mass frame. These observations call into question the traditional picture of oxygen atom chemical dynamics.

NEW ASTM TEST METHOD FOR RETROREFLECTORS

The retroreflectors in sheeting materials are generally glass beads or tiny plastic cube corners. Their applications are diverse and include highway signs and road markers as well as material to be attached to clothing for night-time visibility. The applications cited for ASTM testing requirements represent a large world market and illustrate the importance of these products to the safety and marking uses for a variety of applications.

ASTM recently issued a definition for a new standard test method, "Standard Test Method for Coefficient of Retroreflection of Retroreflective Sheeting." The new test protocol will help the American retroreflector sheeting industry set standards for the manufacture of worldwide competitive products and will help purchasers specify their requirements effectively. A NIST scientist planned, designed, and wrote the precision and bias section for this test method. This accomplishment completes and validates the test method and will enable immediate implementation of an internationally accepted procedure.

To supplement this standard protocol, NIST furnishes a Measurement Assurance Program (MAP) for retroreflection. The MAP service also provides calibration assurance for larger cube corner retroreflectors used intensively in the automotive industry.

DETECTOR-BASED LUMINOUS INTENSITY CALIBRATIONS

The candela is the SI unit for the apparent visual brightness of a light source. Historically, the definition was based on specific standard sources. The sources were originally standard flames and later were freezing point blackbodies. The redefinition of the candela in 1979 placed the candela on a more direct physical basis that allows a flexible approach to the realization of the unit. Recently, NIST completed a realization of the candela using absolute detectors. The change to a detector base has allowed NIST to realize the candela, the unit of luminous intensity, in a more direct manner. Instead of using lamps which had been compared to standard sources to maintain the candela, a set of eight detector packages has been measured directly with respect to the photodetector absolute responsivity scale. The detector packages contain filters to match their spectral responsivities, as closely as possible, to the Commission International de L'Eclairage definition for the relative daylight human eye response.

The measurement chain has been shortened significantly and is directly traceable to the high-accuracy cryogenic radiometer standard. The resulting measurement uncertainty is 0.5 percent (3σ), two times better than the previous scale. The luminous intensity calibration service that NIST provides its customers today reflects that improvement.

NONCONTACT ULTRASONIC SYSTEM FOR PROCESS CONTROL IN AUTOMATED WELDING

A noncontact ultrasonic sensor system has been developed jointly by NIST and the Idaho National Engineering Laboratory (INEL) for the real-time detection of defects created during welding. NIST's role has been to develop a noncontact ultrasonic receiver system that detects ultrasound generated in the weldment by a pulsed laser. The sound will be "shadowed" by defects in its path, resulting in decreased receiver output. The system has been hardened both thermally and electrically to work in the harsh environment of production welding. INEL has integrated the receiver with the pulsed laser source and delivered it to private industry for use in an automated welding system being developed for the Navy.

APPARATUS FOR HIGH-PRESSURE/ HIGH-TEMPERATURE DIFFERENTIAL THERMAL ANALYSIS OF OXIDIZING SOLIDS

A high-pressure/high-temperature differential thermal analysis apparatus has been developed by NIST and is being used to study materials of specific interest in aerospace applications. The primary use of the apparatus is to study the oxidation of metals and alloys at high temperatures in the presence of high-pressure oxygen. Other types of environments and materials, e.g., ceramics and polymers, can be accommodated, however, as long as the gas environment and specimen outgasing is nondestructive to the materials in the apparatus. The operating range is from ambient to 1700 °C and from 130 Pa to 34 MPa. Temperature-time profiles are computer controlled as are all data acquisition operations.

FABRICATION OF TRANSPARENT CERAMICS FROM NANOSIZE PARTICLES

A new approach to fabricating ceramic materials using nanosize particles is under development at NIST. The new approach utilizes nanosize particles for fabricating dense, usually transparent compacts, which subsequently are sintered at significantly reduced temperatures as compared to those of coarse ceramic particles of corresponding materials. Potentially, such materials can have a wide range of industrial applications as structural, optical, or electronic ceramic material. Research has shown that nanosize, amorphous silicon nitride powder can be sintered to hardness over 2000 kg/mm^2 at a relatively low temperature of 1400 °C without using sintering aids. In conventional

approaches, oxides of rare earth metals are used as sintering aids to obtain fully dense silicon nitride ceramics. Currently, efforts are directed toward fabricating larger samples, 3 mm in diameter by 1 mm in thickness, of the transparent amorphous silicon nitride and evaluating its hardness, fracture toughness, and optical properties. In addition, NIST is considering the application of this approach to other ceramic materials that might benefit. A patent has been granted to NIST on this process.

COMPUTATIONAL MODELING OF ADVANCED ALLOY SYSTEMS

The ability to predict microstructural evolution occurring during solidification and solid-solid transformations of multicomponent alloy systems is critical to process modeling for advanced materials. A cooperative project involving NIST, DARPA, and several universities is aimed at addressing this issue. Materials science and mathematical expertise are coupled to apply emerging methods from numerical analysis and dynamical systems theory to predict the evolution of microstructure in advanced intermetallic alloys.

Program goals include:

- New algorithms to describe multiple dendrite growth and concentration variation in the mushy zone during solidification. Techniques employed include phase field methods and geometric measure theory.
- Large-scale computations of cellular automata to model partial ordering and segregation during solid-solid phase transformations.
- Symbolic methods for computation of the symmetry constrained probability distributions of the cluster variation and path probability methods. These formalisms provide the most precise description of multicomponent alloys available in modern materials science, and the ability to solve them offers great opportunities for modeling science.
- The design and implementation of experiments to critically evaluate the theoretical models of developing microstructure. Electron microscopic and x-ray methods will be used to quantitatively follow ordering reactions in situ.

FEDERAL INFORMATION PROCESSING STANDARD (FIPS) FOR KEY MANAGEMENT APPROVED

On April 27, the Secretary of Commerce approved FIPS 171, Key Management Using ANSI X9.17, for federal agency use. ANSI X9.17 is a voluntary industry computer security standard that defines procedures for the manual and automated management of the data (e.g., keys and initialization vectors) necessary to establish and maintain cryptographic keying relationships. The data are known as keying material.

ANSI X9.17 uses the Data Encryption Standard to implement key management practices in a variety of operational environments and contains a number of options. Effective Oct. 30, FIPS 171 specifies a particular set of these options for the automated distribution of keying material by the federal government using the protocols of ANSI X9.17. Systems built to conform to this set of options are more likely to be interoperable, and the cost of building and testing such systems will be reduced.

NEW PUBLICATION FOCUSES ON COMPUTER SECURITY IN FEDERAL PROCUREMENTS

NIST Special Publication 800-4, Computer Security Considerations in Federal Procurements: A Guide for Procurement Initiators, Contracting Officers, and Computer Security Officials, provides guidance on including security in the acquisition of automated information resources. Based on the collective experience of government and industry personnel from the fields of computer security, procurement, and information resource management, the document helps agencies select and acquire cost-effective computer security by explaining how to include computer security requirements in the federal procurement process. The guide supplements existing agency and General Services Administration guidance on procurement and computer security.

INTEGRATED SERVICES DIGITAL NETWORK (ISDN) PUBLICATION SERIES INITIATED

NIST has established a new publications series to present the implementation agreements and other output of the North American ISDN Users' Forum

(NIUF). NIST Special Publication 823-1, Overview of Integrated Services Digital Network Conformance Testing, introduces a series of documents that focus on the conformance test specifications for the various ISDN protocols. The publication provides an outline of the abstract test suites for ISDN and discusses the current status of ISDN conformance testing and related issues. NIST Special Publication 823-2, Integrated Services Digital Network Conformance Testing, Layer 1—Physical Layer, Part 2—Basic Rate U Interface, User Side, describes a set of conformance test specifications for network terminations connected to the basic rate ISDN user-network interface.

NEW DIGITAL SIGNAL GENERATOR COMPLETED

NIST has completed the final step in software and hardware development of a prototype digital signal generator that will be used as the source for a reference-level inductance bridge and, in slightly different versions tailored to each application, for the NIST digitally synthesized source and for various power and energy measurement systems supporting formal NIST services. This last step in the development of the new generator involved the calibration of the composite multiplying digital-to-analog data converters (MDACs) used to synthesize the output waveforms. NIST used five commercial surface-mount, 12 bit MDACs to fabricate a 24 bit MDAC having a static integral nonlinearity equivalent to 18 to 19 bits. A "de-glitching" scheme provides good stepped waveform quality at update rates of 2 MHz. These capabilities represent an improvement by a factor of four in linearity and settling time over those provided by the best commercially available MDACs. The resolution of the new generator is ± 1 ppm in amplitude, ± 1 μrad in phase, and ± 1 part in 10^8 in frequency.

MODEL DEVELOPED FOR CALCULATING MAGNETIC PROPERTIES OF DUAL-LAYER MAGNETIC RECORDING FILMS

In response to a rapidly growing interest in multilayer magnetic recording thin films within the magnetic recording industry, a NIST researcher has developed a micromagnetic model of dual-layer magnetic media, which permits modeling of layers that have differing geometric and magnetic properties. The properties of multilayer films that make them suitable for high-density recording—including cobalt-alloy longitudinal films having superior signal-to-noise ratios and perpendicular recording materials in which the magnetic media are backed by soft magnetic underlayers—depend on complex magnetic interactions within the individual magnetic layers and between layers.

In the model, each magnetic layer is composed of a regular matrix of volume elements. The model treats each element as a single magnetic domain having uniaxial magnetic anisotropy and provides elements with the capability to affect each other by anisotropy, magnetostatic, and nearest-neighbor exchange interactions. The magnetization vector of an element is fixed in magnitude but is free to rotate in space. The nature of this rotation is described dynamically by an equation relating the rate of change of the magnetization vector to impressed torques tending to line it up with an applied magnetic field vector. The equilibrium magnetization distribution of the medium is obtained by simultaneously integrating a coupled system of these Landau-Lifshitz equations for all the volume elements until convergence is reached. The computational effort invested in calculating demagnetizing fields at each iteration grows as the square of the total number of elements considered in the calculation, and the researcher applied the vectorization capability of the NIST Cray-YMP supercomputer to make the calculations practicable with sufficient resolution.

NIST ALGORITHM TO BE USED IN IEEE STANDARD

At a recent meeting, the Waveform Measurements and Analysis Committee (TC-10) of the Institute of Electrical and Electronics Engineers' (IEEE) Instrumentation and Measurement Society adopted a sine wave curve-fitting algorithm developed by NIST as a replacement for an existing method incorporated in IEEE Standard 1057, "Trial Use Standard for Digitizing Waveform Recorders." The new algorithm, the work of NIST scientists, was selected because it converges with fewer iterations than the present method and is simpler to implement in software as a result of its use of high-level matrix operations. When the algorithm operates on data records containing only one or two sine-wave periods, it converges with dramatically fewer iterations than the original algorithm.

In a related action, the committee determined that following completion of the revisions to Standard 1057, it would undertake a comprehensive rework and expansion of the IEEE Guide to Waveform Recorder Testing, to be issued by the IEEE Standards Board as a companion to Standard 1057.

LINE STRENGTHS OF HYDROGEN PEROXIDE

At the request of the U.S. Environmental Protection Agency, a NIST scientist has developed a spectroscopic procedure for the determination of gas mixtures of H_2O_2 as part of EPA's air pollution studies. The concentration values needed to be determined every few minutes instead of every few hours and, since gas mixtures of H_2O_2 are unstable, the spectroscopic procedure required calibration based on its infrared absorption cross section, a fundamental property of the molecule. This fundamental spectroscopic property had not been determined with any great accuracy in the past.

Hydrogen peroxide is a trace atmospheric molecule that plays an important role in stratospheric and tropospheric chemistry. It is a very reactive molecule and one that is difficult to measure by traditional wet chemical techniques. Measurements are time consuming and generally imprecise. However, to truly understand the complex atmospheric reaction mechanisms that form harmful smog and acid precipitation, the peroxide concentration must be known and, therefore, measured.

Tunable diode laser absorption spectrometry was used to determine accurate rotation-vibrational line strengths for a number of transitions. These line strengths were used to calculate the rest of the line strengths and the total overall band strength. A total band strength of $(449 \pm 12)\ cm^{-1}m^{-1}\ kPa^{-1}$ $(464 \pm 12\ cm^{-2}\ amagat^{-1})$ at 273.15 K is the most accurate measurement to date; this is an uncertainty of only 2.6 percent. As a result of this work, it is now possible to make spectroscopic measurements of ambient hydrogen peroxide more rapidly and accurately than before, thus enabling atmospheric chemists to better understand the complex chemistry which results in deleterious pollution.

IEC WORKING GROUP ON TEMPERATURE SENSORS MEETS AT NIST

Members of the Working Group of Technical Committee 65 of the International Electrotechnical Commission (IEC) met at NIST June 3–5. The IEC is an international standards-writing organization, of which the United States is a member. IEC's Technical Committee 65 is concerned with standards related to industrial process measurement and control. This working group specializes in temperature sensors used in those measurements and controls.

The major purpose of the meeting was to adopt new reference functions and tables for letter-designated thermocouples and for industrial platinum resistance thermometers (IPRTs), both of which are used widely in industry. The new reference functions and tables for thermocouples adopted at the meeting are based on the International Temperature Scale of 1990 (ITS-90) and cover the temperature range from −50 to 1768.1 °C (the melting-point temperature of platinum). Data for those functions and tables were obtained in a recent international collaborative effort involving national standards laboratories from eight countries. The analyses of the data and the derivation of all the reference functions and tables were performed at NIST. The new reference function and table for IPRTs adopted at the meeting were based on recent results from two European national standards laboratories. The adoption of these new functions and tables for thermocouples and IPRTs for IEC standards by this working group is the first of several such voluntary standards for science and industry that well-known standards-writing organizations will produce as a result of the new ITS-90-based results.

MOLECULES IN VERY INTENSE LASER RADIATION

The study of the response of atoms and molecules to extremely intense laser radiation has been a subject of great interest at many laboratories in recent years. Conventional lasers do not strongly perturb the structure of an atom or molecule. But if a light pulse of high enough power, say in excess of 10 TW/cm^2, is incident on a molecule, it can rip the molecule apart into atomic pieces in a time comparable to the time scale on which the molecule undergoes its characteristic vibrational motion.

Recent theoretical studies of this process by a NIST scientist in collaboration with a French colleague, have predicted a special new effect that can occur during such an event. Under conditions for which one would expect rapid and complete dissociation of an H_2^+ molecule in a few femtoseconds during an intense laser pulse, there is an onset of stabilization of the higher bound vibrational levels of the molecule. A significant population, as much as 50 percent depending on circumstances, can remain in bound vibrational states throughout the entire pulse. The dissociation is incomplete, and a coherent distribution of excited vibrational states is formed. This survival effect can be attributed to trapping of portions of the initial vibrational wavepacket in transient laser-induced potential wells. The theoretical predictions will be published

in a forthcoming issue of Physical Review Letters. Preliminary experimental confirmation of such an effect has just been measured by a group at the University of Michigan.

DECIPHERING THE WEAK INTERMOLECULAR INTERACTIONS THAT MAKE LIFE POSSIBLE

Everyone knows that strong electromagnetic forces hold electrons to atoms and hold most simple molecules together. Much weaker chemical forces are, however, responsible for many of the wonders of nature that occur on a larger scale, including life itself. For example, proteins and nucleic acids (the stuff of genes and DNA) are actually enormously long molecules whose biological interactions are determined by the very complicated way in which they are folded up into compact structures. These biological molecules are constructed of many, many smaller molecules individually held together by strong forces, but the smaller elements are collectively assembled by very weak interactions that determine the folding structure. These critically important weak forces are very difficult to study and are very poorly understood. Crude fits to bulk properties are about all we have had to go on until recently.

It has now become possible to obtain very high resolution spectroscopic data on how large and complex molecules stretch and bend at the sites of weak bonds by using a new measurement tool called a slit-jet supersonic expansion developed by NIST scientists. The supersonic expansion effectively cools the molecule to the point that the key to the incredibly complex normal spectra can be discovered, simply because most of the molecule's normal vibrational and rotational modes are "frozen out." For example, a recent study of the weak bond between the oxygen and hydrogen atoms in the molecule OCO-HF (a prototype of the similar bond in the common protein structure ...CO-HN...) revealed that it was not a stiff linear structure at all, but much more like a very floppy ball-and-socket hinge. With more of this kind of data to guide us, we will eventually be able to model the dynamics of very large macromolecules.

CONSTRUCTING NANOCOLUMNS WITH A SCANNING TUNNELING MICROSCOPE (STM)

Groups around the world have been using the STM in a furious competition to find new ways to push, pull, and otherwise manipulate individual atoms on surfaces. For example, xenon atoms absorbed on a nickel surface have been dragged to controlled positions, and individual xenon atoms have been moved back and forth between an STM tip and a surface. The holy grail is knowledge that will permit industry to manufacture, in bulk, intricate electronic structures thousands of times smaller than possible at present. Until now, no one has succeeded in constructing any precisely positioned surface structure that has a positive aspect ratio, i.e., is taller than it is wide.

A group of NIST scientists recently cleared this hurdle and created well-defined structures, dubbed nanocolumns, of silicon on both the STM tip and on the sample surface. Surface nanocolumns as tall as 14 nm, but less than 5 nm wide, were routinely created, apparently by dragging atoms together from the surrounding surface material. These nanocolumns were found to be fairly robust after repeated scanning. This is a fundamentally important breakthrough in nanoscale physics, but the horizon remains distant. The next step toward a true STM-based nanotechnology is to show that these structures can be formed from a variety of materials, and that their forms and shapes can be extended in practical directions, e.g., to make lithographic masks and interconnects.

APPARATUS FOR MEASURING THERMAL CONDUCTIVITY AT HIGH TEMPERATURES

A miniature guarded-hot-plate apparatus has been developed at NIST to measure the thermal conductivity of monolithic or composite ceramic materials in the temperature range 500 to 1350 K. It is a steady state, absolute device that will allow comparison to flash diffusivity measurements and will provide modeling data for ceramics, composites, and coated materials. Structural components in the apparatus are made of high-purity alumina, boron nitride, and nickel. Heater elements and measurement sensors are made of thermocouple grade platinum and platinum/rhodium wire. Measurements are made in a helium atmosphere at a gas pressure of 47 kPa. Specimen diameter is 70 mm and allowable thicknesses are 1.5 to 8 mm. The apparatus was designed to operate with specimens having thermal conductivities in the range 0.1 to 20 $W\ m^{-1}\ K$.

Preliminary tests on magnesium oxide and pyroceram, representing the upper end of this range, yielded an uncertainty of less than 5 percent. The heaters and sensors are optimized for operation at 1200 K. At this temperature, the measurement

uncertainty reaches a minimum. Data acquisition and system control are completely automated with the option of performing up to 20 runs without user interaction.

COOPERATIVE RESEARCH AGREEMENT SIGNED WITH INDUSTRY

NIST has initiated a Cooperative Research and Development Agreement (CRADA) with a private company to extend process simulation capabilities developed at NIST for liquid molding of polymer composite parts to commercial aerospace applications. This complements the ongoing CRADA activities between NIST and the three major U.S. automotive companies where the same modeling capabilities are applied to fabrication of automotive parts.

Liquid molding has the potential to lower costs significantly and increase simultaneously both the speed and reliability of fabrication for structural parts made with polymer composites. To achieve this goal, however, the processing parameters must be optimized for a given application, and process simulation models are the key to this challenge. NIST is developing such models but needs cooperation with industry so the computer programs can be tested and refined through comparisons with actual part fabrication. In the new CRADA, the private company will conduct flow visualization experiments with materials and geometries appropriate for aerospace applications. Comparing these results with the model predictions will help expand the range of applications that can be addressed by the simulation programs.

IMPROVEMENTS IN DENTAL RESTORATIVE MATERIALS

ADA research associates at NIST have found an ingenious way to quickly fortify teeth. With a unique method of rapidly applying tooth mineral, researchers are able to help prevent and repair cavities, make teeth less sensitive, and provide a better and stronger way of adhesively bonding restorative materials.

With support from the National Institute of Dental Research, the scientists developed a pressurized carbon dioxide (CO_2) system to quickly coat teeth with calcium phosphate, a tooth mineral. NIST scientists found that the carbon dioxide increased the amount of mineral that can be dissolved in solution and then deposited more quickly through evaporation of the CO_2 on the surface of the tooth. This process helps arrest and repair beginning cavities by strengthening tooth enamel.

The researchers also discovered that the remineralizing process increased the strength of adhesive bonding that hold restoration materials to teeth. During the study, the new technique proved to be as straight- forward as conventional bonding, and the researchers believe that it would require only one additional step, if any, for dentists. People with weak tooth enamel or no fluoride in their drinking water and prone to cavities are good candidates for remineralization and composite restoration bonding techniques. Increased tooth mineral also makes teeth less sensitive to temperature extremes.

METAL-OXIDE MAGNETIC LAYERED MATERIALS

Magnetic films continue to be attractive candidates for low-cost high-density data storage and recording-head materials. While much of the current research concentrates on metallic materials, it recently has become possible to fabricate highly stable transition-metal-oxide magnetic films and superlattices, as well as metal-insulator systems. NIST scientists have been involved in two collaborative research efforts, one with the Center for Magnetic Recording at the University of California at San Diego, and the other with the Center for Materials Research and Technology at Florida State University. These groups are working on NiO/CoO and NiO/Fe_3O_4 films and superlattices. Magnetic neutron diffraction has shown that the magnetic structure of these composite superlattice materials is determined by interactions across the layer interfaces. This indicates that magnetic properties such as magnetization density and anisotropy can be controlled independently by appropriately adjusting individual layer materials and thicknesses. The neutron diffraction studies also suggest that coherent magnetic order is maintained across CoO at temperatures where the Co moments are ostensibly thermally disordered.

NIST VALIDATES MODEL OF FIRE AND SMOKE TRANSPORT

NIST has taken a major step in promoting the use of computer models of fires. Several predictive models of the course of a fire have been developed, but little has been done to demonstrate the accuracy of their predictions. This has limited the application of these models to building design, product development, and code approval. NIST scientists have now completed a comparison of the predictions of a new model, CFAST (consolidated fire and smoke transport), with a series of full-scale fire

tests. The buildings in the experiments include a single room, multiple rooms on a single floor, and a seven-story hotel. The properties examined include the rate of heat release from the fire, room pressure and temperatures, the height of the smoke layer in the rooms, inter-room air flows, and concentrations of oxygen, carbon monoxide, and carbon dioxide. CFAST, documented in NIST Technical Note 1283, predicts the experimental results qualitatively and often quantitatively quite well. A paper, submitted for publication to the Fire Safety Journal, discusses the reasons for the model's success and its shortcomings, and identifies key areas for improvement.

NIST TO SCREEN FIRE-FIGHTING CHEMICALS

The current halogenated fire suppressants (halons) are being phased out rapidly due to their deleterious effect on stratospheric ozone. NIST has been requested to lead the screening of 12 potential alternative chemicals for suppression of in-flight fires in both military and commercial aircraft. NIST will provide data on properties such as flame extinction efficiency, chemical stability, combustion by-products, and metal and elastomer compatibility. In addition, NIST will search for other potential suppressants with high firefighting capability, yet low impact on people, materials and the environment. The principal milestone in the project is a recommendation of the optimal chemicals for full-scale testing at Wright Patterson Air Force Base that will begin in October 1993. Research on long-term compatibility will continue in the following 2 years.

Standard Reference Materials

NIST STANDARD ACCURATELY MEASURES VITAMINS IN BLOOD

Increased serum levels of vitamin A and carotenoids are associated with reduced risks for certain types of cancer, according to studies at the National Cancer Institute. As researchers continue to investigate this relationship, they must rely on precise and accurate measurements of varying levels of vitamins in blood samples. Researchers also must be able to compare measurements made in different laboratories to draw meaningful conclusions. In order to help ensure this critical accuracy, NIST has produced a renewal lot of Standard Reference Material (SRM) 968a for fat-soluble vitamins in blood serum. The SRM contains six vials of freeze-dried human serum with low, medium and high levels of fat-soluble vitamins. It has certified concentrations of beta-carotene, alpha-tocopherol and retinol. The SRM also features a list of approximate values for cholesterol, as well as alpha-carotene, lycopene, zeaxanthin and other fat-soluble vitamins. SRM 968a is available for $196 from the Standard Reference Materials Program, Room 205, Building 202, NIST, Gaithersburg, MD 20899, (301) 975-6776.

REFERENCE MATERIALS 8535–8557– LIGHT STABLE ISOTOPE MATERIALS

The Standard Reference Materials Program announces the availability of a series of light stable isotope Reference Materials (RMs) 8535–8557. The materials can be used in climate change and other environmental studies as well as for hydrologic and geochemical investigations.

Isotopic compositions of these RMs are given as parts per thousand difference from various isotope ratio standards, Vienna Standard Mean Ocean Water (VSMOW, RM 8535) for oxygen and hydrogen isotopics; Vienna PeeDee Belemnite (VPDB) for carbon isotopics; atmospheric N_2 (air) for nitrogen isotopics; and Canyon Diablo Troilite (CDT) for sulfur isotopics. An absolute isotopic ratio $^6Li/^7Li$ is given as well for Lithium Carbonate (LSVEC, RM 8545).

Because of limited supplies, these RMs are limited to one unit of each per customer every 3 years. NIST will distribute RMs 8535-8557 in North America; the original distributor, International Atomic Energy Agency, will continue to be the distributor in the rest of the world.

STANDARD REFERENCE MATERIAL 1853– MAGNETIC PARTICLE TEST RING

The Standard Reference Materials Program announces the availability of Standard Reference Material (SRM) 1853, Magnetic Particle Test Ring, to provide a means for obtaining a leakage field of known value. Such a leakage field is useful for verifying the magnetic particles used in the non-destructive evaluation of cast, forged, wrought, and machined steel parts by means of magnetic particle inspection. This testing is currently done according to three standards, ASTM E-709, MIL-STD-1949, and AMS 2640, all of which call for a test ring fabricated from AISI 01 tool steel to

prove the efficacy of the magnetic particles used in the tests.

SRM 1853 consists of a 127 mm (5 in) diameter, 22 mm (7/8 in) thick ring machined from vacuum arc remelted 52100 steel meeting the requirements of Aerospace Materials Specifications AMS 6444G. The lot of material used for SRM production had a coercive force of 610 A/m and a hardness of HRB 86 on the Rockville B scale. The microstructure consists essentially of spherodized cementite in a ferrite matrix.

NEW REFERENCE STANDARD FOR COORDINATE MEASURING MACHINE

NIST has produced a reference artifact for use with coordinate measuring machines (CMMs). The unit is designed for use with the recently revised ANSI standard (ANSI/ASME B89.1.12) to test CMM probe performance and repeatability; in addition, it can be used in the probe calibration process. The artifact includes high-precision spheres that have been calibrated to better than 0.1 μm for both sphericity and diameter. The artifact will be distributed to industry through the Standard Reference Materials Program as SRM 2804.

A NEW STAGE MICROMETER FOR SCANNING ELECTRON MICROSCOPY SRM 484H

A NIST group, in cooperation with the Office of Standard Reference Materials, is producing a new standard to calibrate the magnification on an SEM. This new micrometer differs from the old standard (still available) in that the smallest line spacing is now 0.50 μm, whereas the older standard has 1.0 μm as the finest spacing. The standard is made by electrodepositing very fine lines (layers) of gold between relatively thick layers of nickel. Certification of the line spacing is conducted on an SEM equipped with a laser interferometric measuring system.

Standard Reference Data

MOLTEN SALTS DATABASE EXPANDED TO INCLUDE MIXTURES

Materials scientists and chemical engineers now have an expanded resource with important properties of molten salts and salt mixtures. Designed for personal computers (PCs), the NIST molten salts database provides users with rapid access to data for approximately 320 single salts and more than 4000 salt mixtures in the molten state. The properties in the database are density, surface tension, electrical conductance, and viscosity. This information is particularly helpful for researchers engaged in the development of new high-temperature advanced materials for aerospace products and for scientists performing high-temperature and high-pressure physical property measurements. The new version of the PC database is available for $240. Owners of a previous version can update for $100. To order Molten Salts Database: Single Salts and Mixtures, Version 2.0 (NIST Standard Reference Database 27), contact the Standard Reference Data Program, A320 Physics Building, NIST, Gaithersburg, MD 20899, 301/975-2208, fax: 301/926-0416.

PC DATABASE FOR ATOMS AND ATOMIC IONS AVAILABLE

Analytical chemists, biologists, environmental scientists, astrophysicists and others who use atomic spectroscopy to detect unknown atoms and atomic ions now have a personal computer database that provides easy access to information on the brightest emission lines for all neutral atoms and their first four stages of ionization. The NIST Spectroscopic Properties of Atoms and Atomic Ions Database, Standard Reference Database 38, provides reliable atomic data essential in such areas as plasma diagnostics, laser physics, and astronomy. The database includes atomic masses, ground-state configurations and terms, and ionization potentials for the neutral atoms and ions. Atomic weights, abundances, nuclear spin, dipole moments, and quadrupole moments also are given for all stable isotopes. The database is available for $190 from the Standard Reference Data Program, A320 Physics Building, NIST, Gaithersburg, MD 20899, (301) 975-2209, fax: (301) 926-0416.

MASS SPECTRAL DATABASE EXPANDS, ADDS NIH

A major international resource used by analytical chemists and environmental scientists to identify unknown substances now contains spectra for 62235 chemical compounds. The update of the NIST/EPA/NIH Mass Spectral Database is available on disks for personal computers (PCs) or for lease in a magnetic tape format. Since the last update, a large number of spectra have been evaluated in a major effort to upgrade the collection's quality by locating, correcting or eliminating all poor quality spectra. The name—formerly the NIST/EPA/MSDC Mass Spectral Database—also has been changed to reflect a long-range collaboration with the National Institutes of Health (NIH). The emphasis is on commercially, environmentally and medically important compounds relevant to real-life analyses. The PC version, Version 4.0, is available for $1200 from the Standard Reference Data (SRD) Program, A320 Physics Building, NIST, Gaithersburg, MD 20899, (301) 975-2208, fax: (301) 926-0416. Upgrades from previous PC editions are $200. To obtain a license agreement for the magnetic tape version, contact the SRD Program.