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News Briefs

General Developments

Inquiries about News Briefs, where no contact person is identified, should be referred to the Managing Editor, Journal of Research, National Institute of Standards and Technology, Building 820, Room 126, Gaithersburg, MD 20899-0001; telephone: 301/975-3572.

NIST RESEARCH SHOWS NANOCOMPOSITE CAN TAKE THE HEAT

Remember the scene in "The Graduate" when a would-be mentor wraps his arm around young Benjamin and says, "I've got just one word for you . . . Are you listening? . . . Plastics!" If that film were being made in 1997, that one word might be nanocomposites.

Nanocomposites are super plastics—compounds in which about 1 nm size particles of montmorillonite clay are dispersed throughout the polymers involved. NIST researchers have found that this new class of materials is tops in flame retardancy.

Flammability in plastics is a major concern because fires started in the synthetic fabrics found in carpeting, upholstery, furniture or bedding often lead to property damage, injury or death. NIST's experiments show that the heat release rate—the most important parameter for predicting fire hazard—is reduced 63 % in a nylon-6 clay-nanocomposite containing a clay content of only 5 %. According to one of the NIST researchers, the clay additive, unlike other fire retardant additives, does not degrade the overall material. Industry tests show the hybrid nylon-6 clay nanocomposite, compared to pure nylon-6 based plastic, has 40 % higher tensile strength (resistance to breakage), 68 % higher tensile modulus (ultimate level of resistance to breakage), 60 % higher flexural strength (ability to be bent or twisted without breaking) and 126 % increased flexural modulus (ultimate level of ability to be bent or twisted). The NIST researchers also said that, unlike many chemical fire retardants, nanocomposites produce no increase in carbon monixide or soot during combustion.

NIST plans to host a conference in the near future where scientists and plastics industry representatives will discuss setting up a research consortium to further study nanocomposite flame retardancy properties.

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RESEARCH MAY HELP HUNT FOR INTERSTELLAR IRON

Scientists from NIST, Oxford University, and the University of Bonn recently made spectral observations of the iron deuteride (FeD_2) molecule near 6.9 THz (43 μm) using laser magnetic resonance spectroscopy. These are the highest frequency far-infrared LMR observations ever recorded and the first FIR observations of a vibrational bending spectrum made using LMR spectroscopy.

The FeD_2 observations are important because they provide accurate spectral information for researchers to search for iron in the interstellar medium—an existence that has yet to be documented. In addition, the development of the technology used to make the observations opens up significant new opportunities for important measurements in radio astronomy and upper-atmospheric research.

The international team modified a spectrometer so that it allows measurements at frequencies as high as 9 THz, just about the same as the upper limit for radio astronomy measurements. This expanded range of LMR measurement now covers fine-structure transitions in a number of atoms and molecules, providing the potential for making the exacting laboratory frequency measurements needed to support searches for these species in space.

Closer to Earth, the researchers soon may use their new ability to assess the level of chlorine oxide (ClO), an important molecule in the upper atmosphere. ClO has a fine structure transition at 8.2 THz, which should be detectable by the improved LMR spectroscopy. This

data would provide needed information on atmospheric chemistry relating to depletion of the ozone layer.

A paper, no. 29-97, describing the work is available from Sarabeth Harris, MC 104, NIST, Boulder, CO 80303-3328, (303) 497-3237, sarabeth@boulder.nist.gov>.

NEW STANDARD IS BOON TO "SMART" SENSORS

With the approval of a new interface standard developed by NIST and industry, users and makers of sensors and actuators soon may be exulting in diversity, rather than lamenting it.

Just adopted by the Institute of Electrical and Electronics Engineers, the digital standard (IEEE-1451.2) provides a common "smart" link between transducers (the collective term for sensors and actuators) and microprocessors. The interface could spur some healthy mingling of technologies and applications in what is now a highly fragmented market.

Numbering about 3000, transducer manufacturers have tended to specialize in application areas, each favoring a small subset of the multitude of control-network alternatives. "It has been too costly," explains a NIST scientist, chairman of the IEEE committee that developed the standard, "for many transducer manufacturers to customize their interfaces to the particular requirements of each network." Consequently, industrial customers' technology options also were limited, despite the burst of innovation in sensors and actuators.

The IEEE standard is network independent, able to work with microprocessors designed for any of the various control networks. It features a standard digital format for transferring data from transducer to processor. The format includes a transducer electronic data sheet—or TEDS—that contains information ranging from date code and serial number to sampling rate and date of last calibration. TEDS, says the NIST scientist greatly simplifies the installing, integrating and maintaining of transducers. More than 25 companies contributed to the development of the standard.

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TENTH BALDRIGE AWARD GIVEN TO FOUR U.S. COMPANIES

Two manufacturers—one for a second time—and two service firms have received the Malcolm Baldrige National Quality Award for their achievements in quality and business performance. The 1997 awards, announced by President Clinton and Commerce Secretary William Daley on Oct. 15, 1997, went to 3M Dental Products Division, St. Paul, MN (manufacturing); Solectron Corp., Milpitas, CA (manufacturing); Merrill Lynch Credit Corp., Jacksonville, FL (service); and Xerox Business Services, Rochester, NY (service). Solectron Corp. also won the award in the manufacturing category in 1991.

Congress established the Baldrige Award in 1987; the first awards were presented in 1988. With this year's 10th anniversary recipients, the total number of companies honored is 32. The award's goals are to enhance U.S. competitiveness by promoting quality awareness, recognize quality and business achievements of U.S. companies, and publicize these companies' successful performance. It is not given for specific products or services.

Further information on the 1997 award winners and the award itself is available on the World Wide Web at <http://www.quality.nist.gov>.

"TAKE FIVE" TO LEARN ABOUT NIST IN NEW VIDEO

A new video, "NIST in 5 Minutes and 41 Seconds," takes viewers on a quick but informative tour of the agency and its portfolio of four major programs for U.S. industry's success: the Advanced Technology Program, the Manufacturing Extension Partnership, the Laboratory Program and the Baldrige National Quality Program.

Highlighting the four segments are interviews with some of NIST's industry customers who describe the benefits of partnering with the agency.

For a free, single VHS copy of the video, send a self-addressed mailing label to Public Inquiries, A903 Administration Building, NIST, Gaithersburg, MD 20899-0001; call (301) 975-3058; fax a request to (301) 926-1630 or send an e-mail message to inquiries@nist.gov.

CALORIMETER MAKES BETTER GAS AND LIQUID MEASUREMENTS

The specific heat capacity of a substance is a quantity of considerable interest for many industrial applications. Reliable thermal property data are required for efficient design in the field of chemical engineering. NIST has used the adiabatic method to measure heat capacity for nearly 4 decades. A NIST scientist developed a low-temperature adiabatic calorimeter in 1961 that has been used to measure constant-volume heat capacities for many fluids at temperatures from 20 K to 345 K and at pressures to 35 mPa.

Now, NIST scientists have designed, built, and characterized a new calorimeter that extends the upper temper-

ature limit to 700 K without any compromise in accuracy. A recent paper describes the experimental apparatus, discusses its principles of operation, presents the results of performance tests, and provides an assessment of uncertainties.

For a copy of paper no. 39-97, contact Sarabeth Harris, MC 104, NIST, Boulder, CO 80303-3328, (303) 497-3237, <sarabeth@boulder.nist.gov>.

MULTIPLE PRECISION SOFTWARE IMPROVES ALGORITHM TESTING AND EVALUATION PROGRAM SERVICE

The Algorithm and Testing and Evaluation Program (ATEP) is a special testing service offered by NIST to evaluate the performance of algorithms used in coordinate metrology software. Manufacturers can use ATEP to quantify their software uncertainty in uncertainty budgets as required by ISO 9000. The Algorithm Testing System (ATS) is the computational tool NIST uses in performing the ATEP service, which compares a customer's results to its own, highly accurate, reference algorithms. There exist a few key places in the ATS where it is advantageous that it perform arithmetic at greater than double precision. The multiprecision arithmetic would allow NIST to provide customers with the more accurate reference algorithms with lower uncertainties. However, pre-written multiprecision packages did not suit ATS' needs, so NIST scientists wrote a multiprecision package in C++ to perform these arithmetic operations. With this new software, no special characters or routines need to be called when multiprecision operations are needed since the operators (+,–, *, /, >, <, =, etc.) have been overloaded. By overloading the function, a user uses the standard symbol to carry out the multiprecision operation (e.g., C = A * B works when A and B are any combination of single, double, or multiprecision numbers). Square roots and a few trigonometric functions also were written. Although the functions are expectedly slow, they work quite well. As a performance check, these routines were used to successfully calculate a few hundred digits of pi.

NIST PUBLISHES MINIMUM INTEROPERABILITY SPECIFICATION FOR PUBLIC KEY INFRASTRUCTURE (PKI) COMPONENTS

The Minimum Interoperability Specification for PKI Components (MISPC) provides a basis for interoperation between PKI components from different vendors. The specification supports interoperability for a large-scale PKI that issues, revokes, and manages public key certificates that bind public keys used for digital signatures to their owners. Interoperable PKIs are essential as more and more business transactions are carried out electronically. NIST developed the specification with the cooperation of 10 industry partners under Cooperative Research and Development Agreements. The work is published as NIST Special Publication 800-15.

Key features introduced by the MISPC have been incorporated into industry standards, such as the Internet Engineering Task Force PKIX (Public Key Infrastructure Using X.509) documents. The convergence of PKI specifications increases vendor and consumer confidence and encourages the development and procurement of PKI components.

NEW INSIGHT INTO PROPERTIES OF MAGNETIC NANOSTRUCTURES

Ultrathin magnetic multilayer structures offer great promise for the next generation of data storage devices, but their ultimate performance limits remain to be determined. Ever since the discovery of a new force between magnetic films separated by nonmagnetic spacer layers of nanoscale thickness, researchers have been puzzled by the order-of-magnitude discrepancy between measured and theoretically predicted coupling strengths.

A forthcoming article in Physical Review Letters by NIST scientists has resolved this discrepancy by showing that theoretical limits are attained in nearly ideal, atomically precise, multilayer structures. The NIST team made such structures by growing lattice-matched iron/gold/iron sandwiches on extraordinarily smooth iron surfaces: single-crystal whiskers with flatness equivalent to elevation changes of about 1 m in 5 km. By fabricating the gold spacer layer in a wedge shape, the thickness dependence of the interlayer coupling strength could be captured in a single image, obtained with a novel confocal magneto-optic microscope developed specifically for the project. The measured coupling strengths were an order of magnitude larger than previously measured for such systems, but still slightly less than predicted by theory. The residual difference was predominantly due to layer microroughness that was meas-ured using the reflection high-energy electron diffraction technique. Modeling the effects of this roughening brought the measured results into excellent agreement with theoretical predictions. These results point the way toward better understanding of the effect of growth on magnetic multilayer systems.

LASER-LIKE ATOMIC BEAMS: COHERENCE PROPERTIES OF MATTER WAVES

The light of everyday experience is electromagnetic radiation generated by numerous uncorrelated thermal sources, so that a light wave at a given place or time generally has no definite relationship to that at any other place or time. A laser, on the ot her hand, concentrates light emitted from independent radiators that possess a common phase relationship, so it produces a light wave that maintains phase coherence over a large region. This is of key importance in many technical applications, such as interferometric testing of optical components and the manufacture of holograms.

That matter exhibits wave-like properties analogous to those of light has been known since the advent of quantum mechanics in the 1920s, but until recently there was no feasible mechanism known that could generate laser-like action of matter waves. The attainment of Bose-Einstein condensation in rubidium vapor at JILA in 1995 provided the first practical glimpse of such a mechanism, and researchers at MIT reported an operational prototype of an "atom laser," using a similar sodium vapor system, early in 1997. The coherence properties of matter-wave sources are intrinsically more complex than those of optical sources, since atoms, unlike photons, undergo mutual interaction.

Researchers at NIST have now developed a theory of matter-wave coherence applicable to current Bose-Einstein condensates. Their work shows that atom laser sources operating at nonzero temperatures will produce beams that have laser-like coherence properties at their core, but incoherent thermal characteristics at their edges. It suggests that even in a complex, relatively high-temperature system, it may be possible to selectively extract an atomic beam of high coherence. Their report, containing animated graphics, appears in the Oct. 13, 1997, issue of Optics Express, the online journal of the Optical Society of America, accessible at <http://epubs.osa.org/opticsexpress>.

PRECISION CHEMISTRY OF OXYGEN REACTIONS

A new oxygen-atom source developed by researchers at NIST enables difficult measurements of the chemistry of oxygen reactions. The new source uses laser-induced dissociation of ozone, followed by efficient quenching of reactive species in collisions, to produce a molecular beam source that delivers a pulse of oxygen atoms that are purely in the ground electronic state. The chemistry of these atoms plays essential roles in combustion, propulsion, and atmospheric systems, but they have not been well studied in the past because available oxygen-atom sources typically produce more energetic species that mask the reactions of the ground-state atoms.

The researchers tune the energies of the oxygen source and target molecules to induce near-threshold, single collision reactions. Example targets are molecules such as hydrogen, water, methane, and silane, which play critical roles in environmental and industrial processes. The researchers use lasers to optically manipulate the reactants to produce highly controlled reaction conditions, enabling the study of the molecular forces that govern the basic chemical processes.

The data developed by the NIST apparatus will help to improve and validate theoretical models of chemical processes that involve oxygen, including quantum mechanical models of the most elementary reactions, climate change predictive models, and industrial process models. Data on ground-state oxygen-atom interactions also are needed to understand and control the interactions of spacecraft in low earth orbit, such as certain communication and instrumentation satellites, the space shuttle, and the space station, as well as hypersonic aircraft.

NEW ACCURACY ACHIEVED IN NEUTRON SCATTERING-LENGTH MEASUREMENTS

Scientists at NIST and a visiting physicist from the Hahn-Meitner Institute in Berlin have achieved a significant advance in the measurement of neutron scattering lengths at the neutron interferometer (NI) at the NIST Reactor. The scattering length is a measure of the strength of the interaction between an impinging neutron and its target. Accurate scattering-length data are useful both for fundamental research in nuclear and sub-nuclear physics and for applied research in materials science and in radiography and tomography.

The nuclear coherent scattering length for neutrons scattered by silicon atoms was measured with a relative uncertainty of 0.006 % (one standard deviation), an improvement of a factor of five compared to the best previous measurement. This advance was made possible by a new wavelength-independent NI technique and by the superior stability and fringe visibility of the NIST NI system.

The silicon scattering length results have been presented at a technical meeting and submitted to a journal for publication. This new capability is currently being employed in an experiment that will determine the basic shape of the internal charge distribution of the neutron.

STRBase: A SHORT TANDEM REPEAT DNA DATABASE

DNA typing for human identity testing purposes recently has become an important area for both scientific and legal communities. The rapid growth in the field has made it difficult for forensic and paternity testing laboratories to adapt and to standardize the

constantly developing DNA technologies. Scientists at NIST have developed two NIST Standard Reference Materials (SRMs 2390 and 2391) to aid the standardization process and have developed a new database to help centralize information on DNA typing, specifically in the area of short tandem repeat (STR) DNA markers. To make the STR data more readily available to the DNA typing community, more than 450 references pertaining to STRs have been gathered and compiled into an Internet accessible DNA database, which has been named STRBase. STR fact sheets are included that contain information on commonly used STR markers. The fact sheets show observed alleles (and reported microvariants) with their repeat structure and their PCR product sizes using published primers. A list of population studies and references specific to the STR locus of interest also are included. A chromosomal index of identity testing markers is another resource in STRBase.

The data include information from 750 population studies reported in the literature. For each study STRBase lists the STR system, the population examined, the number of unrelated individuals tested, and the reference. This index of population studies should be valuable for locating references that contain useful STR allele frequencies to aid in calculating matching probabilities for DNA typing cases. STRBase will be available to the general public through the World Wide Web starting this fall. This web site should serve as a valuable tool for the continued development and application of STR systems to the field of human identity testing.

NIST, CU COLLABORATION APPLIES NEW MEASUREMENT METHODS TO EXHIBIT SUB-NANOSECOND SWITCHING TIMES IN MAGNETIC RECORDING HEAD MATERIALS

A NIST scientist, in collaboration with colleagues at the University of Colorado, Boulder, has measured magnetic rotation times in thin-film Permalloy using both optical and inductive techniques with unprecedented temporal, spatial, and dynamical resolution. Using optical sampling techniques with a femtosecond Ti:sapphire laser, they observed 1 ns, 90° rotation times in 50 nm Permalloy when driven with 400 A/m pulsed magnetic fields. Inductive measurement using samples with larger anisotropy and larger field pulses have detected rotation times of 200 ps, five times faster than any previously measured rotation speeds. As the disk drive industry continues to push the annual areal density growth rate in excess of 60 %, concerns are being voiced that recording heads will not be capable of operation at the extreme data rates predicted for the next decade, expected to be over 1 z, as contrasted with today's 200 MHz. This work addresses that concern.

The team uses magnetic field pulses delivered by both microstrip and co-planar waveguides which are driven with large-voltage step-function generators. The magnetic samples are placed in intimate contact with the waveguides, exposing the samples to the magnetic component of the electro-magnetic wave propagating in the waveguide. The bandwidth limitations of many soft ferromagnetic materials are in large part determined by the rate at which they can dissipate precessional energy induced by an applied field pulse. When pushed to frequencies approaching 1 GHz, the magnetization in a sample will tend to rotate about the net magnetic field direction in a process called ferromagnetic resonance. For a magnetic material to be useful for data storage applications, such resonance effects must be suppressed, since high data rate signals are not only high in frequency but large in bandwidth as well. The measurements at NIST and CU reveal that the damping of precessional energy is facilitated by both inhomogeneities in the magnetic fields within the magnetic sample and application of extremely short rise-time field steps. Fe-Ta-N, an alternative material to Permalloy for magnetic heads, has been found to exhibit a stronger damping than Permalloy by a factor of two, suggesting that Fe-Ta-N may be a better candidate as a material for next-generation high-speed recording heads. These measurements are being conducted to determine the fundamental limits to magnetic data storage. The goal of the research program is to provide the magnetic data storage industry with the measurement tools and engineering principles necessary for the design and fabrication of advanced recording heads.

PROBING THE ANTIFERROMAGNETIC SPIN STRUCTURE IN "EXCHANGE-BIASED" FE_3O_4/CoO SUPERLATTICES

Recently, the magnetic recording industry has discovered that "exchange-biased" magnetic systems show great promise for application in high sensitivity magnetic sensors. These systems typically consist of a ferromagnetic (FM) layer in contact with an antiferromagnetic (AFM) layer. Due to the exchange interaction with the AFM layer, the FM hysteresis loop exhibits an unusual bias or field shift. However, the "exchange-biasing" effect is highly dependent on temperature, layer thickness, and growth morphology in ways not predicted by standard models. While most experimental techniques are sensitive only to the behavior of the FM layer, researchers at NIST have been studying the role of the antiferromagnet layer using neutron diffraction methods. In collaboration with a private company, a series of molecular beam epitaxy superlattices of Fe_3O_4/CoO has been investigated. These neutron diffraction

measurements are uniquely capable of determining the CoO spin structure in buried layers. The experiments have revealed striking features in the onset of magnetic ordering, the direction of the AFM spins, and the size of the AFM domains. In particular, an unexpected perpendicular coupling between the Fe_3O_4 and CoO moments has been observed, which is related to the biasing behavior. The implications of this new finding for magnetic sensor applications are being explored.

FIRST DIRECT OBSERVATION OF THE DEFORMATION OF METALLIC NANOLAMINATES

Nanolaminates, a new class of materials composed of alternating, sub-micrometer thick layers of two or more species, already have applications in many fields, including microelectronics, magnetic recording, and optics. Increasingly, nanolaminates are being studied for their mechanical behavior, driven in part by the observation that they exhibit hardnesses that are much greater than either constituent material. In addition to this high hardness, there are possibilities of tailoring the toughness of the structure through the use of ductile-phase layers and improving the adhesion to a substrate through compositional grading of the interface. When nanolaminates are fabricated by alternate deposition of layers of materials, the ability to control the thicknesses of the layers down to the atomic level allows the optimization of these properties for specific applications.

Underlying deformation mechanisms that could account for the very high measured strengths and toughnesses of some nanolaminates have been proposed but not experimentally confirmed. Using a deformation experiment carried out in situ in a transmission electron microscope and a novel sample geometry, NIST scientists have observed how the defects known as dislocations, the motion of which allows crystalline materials to deform, are generated and arranged within a copper-nickel nanolaminate. Dislocations we re seen to be emitted from sources on the interfaces between layers. It was possible to observe the arrangement of dislocation arrays within the layers, their motion from layer to layer, and their interaction with interface stresses. For the first time, it was possible to observe how dislocations in a nano-laminate pile up into concentrated arrays, and thus to make realistic calculations of the stresses at the head of these arrays, which is estimated to nearly equal the theoretical shear strength.

Applications of these observations include validating models that describe thermomechanical fatigue damage in microelectronic devices and wear damage accumulation in magnetic storage devices.

ENERGY-RELATED INVENTIONS PROGRAM MAKES RECOMMENDATIONS

During the month of August 1997, the NIST Office of Technology Innovation recommended one innovative technology for commercialization to its Department of Energy partner under the Energy-Related Inventions Program.

Mag/Gate—System for Molten Metal Flow Control is a device that uses strong direct current magnetic fields to control the flow rate of molten metal instead of high frequency alternating current magnetic fields in continuous steel casting processes.

NVLAP RECOGNITION AGREEMENTS

NIST's National Voluntary Laboratory Accreditation Program renewed the bilateral Memoranda of Understanding with laboratory accreditation bodies in New Zealand (International Accreditation New Zealand, IANZ) and Australia (National Association of Testing Authorities, NATA) that were first signed 15 years ago. The signatories agree to recognize the operation of each other's laboratory accreditation programs as equivalent and to promote the acceptance of test reports and calibration certificates produced by accredited laboratories in each country.

The renewals, which now include accreditation of both testing and calibration laboratories, are based on exchanges of on-site assessments, quality system reviews, and interlaboratory comparison studies according to the requirements of ISO/IEC Guide 58, Calibration and Testing Laboratory Accreditation Systems-General Requirements for Operation and Recognition. Evaluation teams also observed the conduct of actual laboratory assessments in each country.

MUTUAL RECOGNITION AGREEMENT BETWEEN THE UNITED STATES AND THE EUROPEAN UNION

On June 20, 1997, the United States and the European Union (EU) initialed an agreement to recognize each others' assurance of conformity of certain regulated products to applicable testing, inspection, and certification requirements of the other party. This agreement covers telecommunications equipment, electromagnetic compatibility, electrical safety, medical devices, pharmaceutical good manufacturing practices, and recreational craft. The full text of the agreement (89 pages) is available on the International Trade Administration's home page at http://www.iep.doc.gov/mra/mra.htm. This Mutual Recognition Agreement (MRA) will enter

into force upon ratification by EU member governments. After entry into force, the agreement will be phased in and fully implemented in 2 years for electronic products and 3 years for health products. NIST is identified in the MRA as a designating authority in four of the six covered areas.

Currently, the conformity to applicable technical requirements of regulated products imported into the EU must be assured by a designated European laboratory or certification body. This has caused significant uncertainty, delays, and costs for U.S. manufacturers and has forced some manufacturers to withdraw products from the European market. When fully implemented, the MRA will allow U.S. manufacturers to submit products to U.S. designated laboratories or certification bodies for approval to EU legal requirements. During the transition phase of the MRA, EU regulatory authorities will accept test results from designated U.S. entities.

NIST's responsibility under the MRA is to "designate, monitor, suspend, remove, suspension of, or withdraw conformity assessment bodies as specified under this agreement." Two programs at NIST are involved in the implementation of the MRA: the National Voluntary Laboratory Accreditation Program and the National Voluntary Conformity Assessment Evaluation Program (NVCASE). Under NVCASE, NIST can evaluate U.S.-based conformity assessment bodies as a basis for providing assurances to a foreign government that qualifying bodies meet that government's requirements and can provide results that are acceptable to that government. OSS's Global Standards Program is handling oversight and coordination with ITA et al. NIST staff have begun discussions with cognizant U.S. regulatory agencies and private-sector representatives, as well as with EU Commission officials, on designation procedures, with the goal of providing an initial list of qualified test laboratories to the EU by the end of the year. The MRA also provides for a series of workshops intended to develop a full understanding of both U.S. and EU mandatory testing and approval procedures. These workshops will be an important component of the MRA transition phase, as both sides move from the exchange of test results to full delegation of product approvals.

NIST RELEASES NEW VERSION OF INDOOR AIR QUALITY MODEL

NIST has released a new version of the CONTAM simulation program for multizone airflow and indoor air quality analysis. Poor indoor air quality is a major national problem based on the impacts on healthcare expenses, the costs associated with reduced productivity of building occupants, and the impacts on the performance of students in educational buildings. The latest version of the CONTAM program, CONTAM96, can perform airflow and contaminant dispersal analysis on a wide variety of complex multizone building systems. The program employs an element assembly approach to describe a building as a series of well-mixed zones connected by airflow elements such as doorways and mechanical ventilation system airflows. Additional elements are used to describe contaminant sources, sinks, and air filters. The most significant elements in CONTAM96 are the inclusion of a ventilation system model and the ability to estimate occupant exposure to airborne contaminants. The program typically is used on a PC-compatible system and can analyze the performance of a building for an entire year in only a few minutes of run-time. CONTAM96 will be used by researchers and the design community responsible for building ventilation and airflow, such as smoke control system designers. CONTAM96 is described in detail in its user's manual, NISTIR 6056.

GAGE BLOCK INTERCOMPARISON DATA PRESENTED

Data for an international intercomparison of gage blocks, which was performed late in 1996, were recently distributed to the participants. NIST was a primary participant, along with the national laboratory from the Netherlands, NKO. Four other U.S. laboratories also participated in the intercomparison sponsored by the American Association for Laboratory Accreditation, A2LA. Nine gage blocks of three different materials were measured. The sizes ranged from 1 mm to 100 mm. All laboratories performed satisfactorily. The NIST-NKO data were particularly consistent showing no evidence of length dependent errors. All NIST-NKO data agreed to better than 30 nm. Systematic shifts of 10 nm to 20 nm present in the data are probably a result of wringing effects and phase change corrections.

NIST RESEARCHER COLLABORATES WITH INDUSTRY AND ACADEMIA TO STUDY DYNAMIC EFFECTS IN HIGH SPEED MILLING

A NIST researcher is working with a private company, the Pennsylvania State University, the University of Florida, and the University of Maryland to address the problem of dynamic errors in high-speed milling. The speed and power of production-grade machining centers has been increasing rapidly over the past 10 years. However, with these increased speeds, machining operations are becoming more complex. The combination of thin-walled components; longer, more flexible tools; and

increased tool rotation rates significantly reduces the dynamic stability of the machining process. A commercial high speed mill, is being used in the investigation of the effects of dynamic errors on high-speed milling.

FIRST ANNUAL USERS MEETING OF THE NIST RADIOCHEMISTRY INTERCOMPARISON PROGRAM

The First Annual Users Meeting for the NIST Radiochemistry Intercomparison Program (NRIP) was held in Carlsbad, N.M., recently. It marks the successful completion of the first year of the traceability program for low-level radioactivity measurements for environmental monitoring.

NRIP was formed to implement ANSI N42.23. This voluntary standard defines a hierarchy of traceability, with an unbroken linkage from service laboratories to NIST. Under the standard, the transfer standards to be used are (1) of appropriate matrices (i.e., matrix categories commonly analyzed by the laboratory) and (2) of appropriate (ambient) activity concentration ranges for these matrices. Currently, NRIP is the only traceability program providing performance evaluation materials at environmental levels.

The distribution dates and sample matrices for fiscal year 1998 were decided at the meeting. Matrices for the coming year include both environmental (aqueous solutions, glass-fiber filters, and soil) and bioassay (artificial urine and fecal material) samples. The analyte list has been expanded to include 90Sr, 234U, 238U, 238Pu, 239/240Pu, and 241Am, at 0.03 Bq to 0.3 Bq per sample.

The meeting also attracted representatives from national laboratories, the U.S. Department of Energy, state environmental monitoring laboratories, and commercial laboratories. Growth in the number of participating laboratories is anticipated.

INTERNATIONAL WORKSHOP ON ULTRASONIC AND DIELECTRIC MEASUREMENTS HELD IN GAITHERSBURG

NIST hosted and co-sponsored the first International Workshop on Ultrasonic and Dielectric Characterization Techniques for Suspended Particulates in Gaithersburg recently. There were 63 registered participants representing nine countries, and including 18 industrial companies, six instrument manufacturers, 19 universities, two national laboratories, and one foreign office of science and technology.

The objective of the workshop was to provide a focus on emerging measurement technologies based on the application of high-frequency acoustic and electric fields for characterizing fine particulates and emulsions in liquid systems of critical importance to a variety of industries. Topics included electroacoustics, acoustic attenuation, acoustic velocity, and dielectric dispersion. The technical sessions consisted of 26 presentations, which emphasized fundamental aspects, instrument design, process control, and specific material applications in both inorganic and organic systems. During an open forum, participants discussed various technical issues related to the further development and application of ultrasonic and dielectric techniques; a consensus was reached on high-priority needs, which included a standard terminology, reference materials, a materials property database for ultrasonic applications, and improved communication between research laboratories developing these techniques. The workshop proceedings will be published by the American Ceramic Society.

INFORMATION EXCHANGE HELD BY NIST AND AIST/JAPAN

The Third Joint Information Exchange Forum between the United States and Japan was held at NIST, Sept. 3-4, 1997. These dialogues on standards and conformity assessment issues are designed to strengthen relationships and initiate combined efforts for the Asia-Pacific region. Akira Yamazaki, deputy director-general, Agency of Industrial Science and Technology, Ministry of International Trade and Industry, led the Japanese delegation.

The Japanese delegation described recent developments in implementing their amended Japanese Industrial Standardization law, which became effective on Sept. 26, 1997, and introduced the new Japanese Industrial Standards (JIS) marking system. JIS will adopt the International Organization for Standardization and International Electrotechnical Commission (ISO/IEC) Guide 65 as its criteria for authorizing certification bodies. This authorization is open to foreign certification bodies and will improve access by foreign manufacturers to the Japanese market.

NIST, the Japanese delegation, and invited ANSI officials exchanged information on their respective activities in ISO/IEC, the Asia Pacific Economic Cooperation Subcommittee on Standards and Conformance, the Pacific Area Standards Congress, and under the World Trade Organization/Technical Barriers to Trade. The Japanese have targeted work in color management, pressure vessels, steel and iron, welding materials, and building standards as candidates for cooperation in international fora.

The Japanese reported that they have been operating accreditation schemes for calibration laboratories based

on ISO/IEC Guides 25 and 58 under the Japanese meas-urement law since 1993. They would like to explore cooperation in the accreditation of composite reference materials producers and coordinate an action plan with NIST for the mutual recognition of laboratory accreditation bodies.

NIST officials provided the Japanese delegation with information on the new National Council for Laboratory Accreditation and the National Voluntary Conformity Assessment System Evaluation program. The Japanese also were briefed on the U.S. role under the recently initiated Mutual Recognition Agreement between the United States and the European Union.

Information was exchanged by the participants on activities in international laboratory accreditation programs under the ISO Committee on Conformity Assessment, Asia Pacific Laboratory Accreditation Cooperation, and the International Laboratory Accreditation Cooperation. The Japanese delegation also was briefed on the final Procedures for Implementation of the Fastener Quality Act that were published in the Federal Register on Sept. 8, 1997

THIRTEENTH SYMPOSIUM ON THERMOPHYSICAL PROPERTIES

The Thirteenth Symposium on Thermophysical Properties was held on the campus of the University of Colorado at Boulder recently. This symposium, which continued the series started in 1959, was organized by NIST and the Thermophysical Properties Committee of the ASME Heat Transfer Division.

This symposium, which convenes every 3 years, is the premier international conference concerned with the theoretical, experimental, and applied aspects of the thermophysical properties of gases, liquids, and solids. The areas of thermodynamic and transport properties of fluids and solids were broadly represented. Special topics covered in the 13th Symposium included the following: acoustic, optical, photothermal, and subsecond techniques for measuring thermophysical properties; materials of strong technological interest, namely molten materials, natural gas, thin films, refrigerants, polymer solutions, and supercritical fluids; properties for chemical and metallurgical process design; fundamental topics such as molecular simulation, critical behavior, properties in low gravity, shear effects on property measurements, wetting and interfaces, and structure of fluids; and property data and databases, including demonstrations of computerized databases.

The 13th Symposium attracted almost 600 participants from industry, academia, and government from more than 35 countries. The conference featured 125 sessions with 585 papers, with invited papers on many topics of major current interest. The number of participants and papers represented an increase of more than 40 % from any previous conference in this series. The Proceedings of the 13th Symposium will be published in special issues of the International Journal of Thermophysics and Fluid Phase Equilibria. A volume of preprints was provided on CD-ROM to the participants in the conference. All manuscripts are available on the symposium web site at http://www.boulder.nist.gov/div838/symp13/.

The 13th Symposium also was the forum to present the Yeram S. Touloukian Awa rd to a NIST scientist and to representative of Imperial College, London, United Kingdom, for their distinguished contributions to the field of thermophysical properties.

LOW GAS-FLOW PROFICIENCY TESTING

NIST scientists discussed the results of a proficiency-testing program to ascertain whether industrial calibration systems, often based on primary gas-flow standards, were providing measurements within their stated uncertainty limits. The accurate measurement and control of low gas-flows is important in many industrial processes, for example in the manufacture of semiconductors. The industrial participants in these proficiency tests came primarily from the semiconductor industry and the suppliers of mass flow controllers (MFCs) widely used by the industry. Semiconductor manufacturing requires MFC relative uncertainties of 1 % or better, which the MFC manufacturers attempt to supply using calibration standards that are claimed to have relative uncertainties in the range of 0.5 % to 0.25 %.

To support the testing of such low uncertainty flow standards, the NIST project had to develop new primary standards with relative uncertainties less than 0.1 % and, because such primary standards are not transported easily, a transfer standard with a long term stability at this same level. The paper briefly describes primary standards used for gas-flow measurements, the performance of NIST's primaries, and the new NIST transfer standard. The major focus of the paper, however, was on the outcome of almost a year of testing which included 17 primary standards (many with multiple ranges) at 11 industrial facilities. The tests reported in the paper covered the flow range from 7×10^{-7} mol/s to 7×10^{-4} mol/s for nitrogen gas. Surprisingly, roughly one-half of the tested primary standards were operating outside of their estimated two standard deviation uncertainties with the lower flow ranges generally having larger errors. There was no evidence of a correlation between system design and deviation from the NIST values; although there was a positive correlation

between the experience of the industrial laboratory staff and their being within their stated uncertainty. These tests have greatly assisted the participants in improving the performance of their calibration systems and their operating procedures.

CONSTRUCTION OF THE SURF III FACILITY BEGINS

On Sept. 5, 1997, at 4 p.m., the light from the SURF II electron storage ring was turned off officially in a special celebration attended by many old friends and users of the facility. SURF, the Synchrotron Ultraviolet Radiation Facility at NIST provided the central national basis for absolute radiometry in the far ultraviolet and extreme ultraviolet regions of the electromagnetic spectrum. During the next few months, the historic magnet system will be dismantled to make way for the new magnet system of SURF III.

The goal of the SURF III project is to establish the nation's source-based radiometric standards on a unified synchrotron radiation basis, from the extreme ultraviolet to the far infrared regions of the spectrum. This will result in a significant increase in accuracy of the primary radiometric standard, which will translate into improvements in the secondary standards used by industry and the scientific community. It will enhance the scope and efficiency of NIST calibration services.

The old SURF magnet contains laminated iron designed and shaped for the ac operation of a synchrotron accelerator which existed at NBS from 1953 to 1974, on which the first synchrotron radiation facility, SURF I, was established in 1961. This magnet is the only component of the original synchrotron retained in the conversion to SURF II storage ring operation in 1974. The new 200-ton magnet core will be continuous, not laminated, and will be made of higher-permeability iron. Its higher field uniformity will endow the electron beam with a near-perfect circular orbit, allowing extremely accurate radiometric predictions of the radiated intensity as a function of frequency throughout the electromagnetic spectrum. The upper limit of electron energy also will be increased, allowing the spectral coverage to extend up to photon energies of 500 eV.

SURF III is currently scheduled to become operational in the spring of 1998.

NIST TO PROPOSE INSPECTION STANDARD TO ISO

With the approval of U.S. companies, NIST will advance a proposal to develop an international standard for computer-to-computer exchanges of dimensional inspection information, making it readily available for design, manufacturing, quality assurance and other uses.

In a series of workshops, NIST found that manufacturers often were frustrated by the exclusion of inspection planning and dimensional requirements from computer-aided design packages. Companies also complained that incompatible data formats undermined sharing of part data and inspection results among software applications. NIST and its industrial partners will soon ask the International Organization for Standardization (ISO) to initiate efforts toward a standard to resolve such problems. The request will be directed to the ISO committee guiding further development of STEP, the **ST**andard for **E**xchange of **P**roduct model data. Formally known as ISO 10303, STEP provides an unambiguous format for representing and communicating data relevant to all phases of a product's life cycle.

As proposed by NIST, the new inspection standard would be a component of STEP. NIST researchers anticipate that the existing U.S. Dimensional Measuring Interface Standard would be compatible. The proposed standard's scope of activities would be larger and, as part of STEP, integrated with other product data standards.

For more information, contact Simon Frechette at (301) 975-3335, simon.frechette@nist.gov, or Howard Harary at (301) 975-3485, <howard.harary@nist.gov>.

AN AC VOLTAGE SOURCE WITH QUANTUM MECHANICAL ACCURACY

NIST scientists have demonstrated proof of principle for an alternating current voltage source based on the perfectly quantized voltage pulses of Josephson junctions. Arrays of Josephson junctions form the basis for this standard.

The NIST researchers have been able to demonstrate how a complex pattern of pulses driving an array of 1000 Josephson junctions produces a smooth sinewave voltage with high resolution and accuracy. The arrays use superconductor-normal-superconductor (or SNS) junctions that can generate inherently stable and accurate voltages. The arrays respond to broadband microwave inputs that can be programmed to generate metrologically accurate ac waveforms. The input consists of a long, repetitive digital pulse train clocked at frequencies up to 12 gigabits per second. In preliminary experiments using arrays of 1000 junctions, this SNS technique has been used to synthesize both stable constant (dc) voltages and sinewaves of a few millivolts in amplitude at frequencies up to 1 MHz.

The researchers continue to focus on increasing the clock frequency and the number of junctions in the array in order to achieve a voltage range of plus-or-minus 1 V.

A paper, no. 41-97, describing this development is available from Sarabeth Harris, MC 104, NIST, Boulder, CO 80303-3328, (303) 497-3237, <sarabeth@boulder.nist.gov>.

NIST, USFA STRENGTHEN FIREFIGHTING PARTNERSHIP

American fire prevention and firefighting efforts were strengthened on Nov. 5, 1997, when NIST and the Federal Emergency Management Agency's United States Fire Administration announced joint plans to better meet the research needs of the fire safety community.

The agreement calls for improved and more effective coordination of fire safety efforts through mutual consultation, research coordination and technology transfer. The two organizations promise to: consult on the content and priorities of NIST fire research; improve the exchange of information—between the two organizations and with the fire safety community—relating to research needs and results; increase the transfer of technology between USFA, NIST and their customers; establish joint research program planning, reviews and coordination; and set guidelines for formulating joint and cooperative research activities, support and/or technical assistance tasks.

In addition, NIST and USFA fire officials will meet at least every 2 months to review progress, accomplishments and priorities. Library and web site services will be coordinated, and an annual conference on fire prevention and control will be held.

SEMICONDUCTOR WIRE BONDING "BIBLE" EXPANDED

Every year 4 trillion wire bonds are made to interconnect silicon chips to their electrical circuitry. This process, called wire bonding, is the world's most frequently performed sophisticated manufacturing step. Now, a NIST scientist has made life a little less complicated for those who make such bonds.

The NIST scientist recently revised and expanded Wire Bonding in Microelectronics—Materials, Processes, Reliability and Yield, a technical bible for chip manufacturers since 1989. In addition to reviewing classical metallurgical problems, the updated edition provides information on new materials, new interconnect techniques, and the pros and cons of alternative bonding technologies. It offers guidance on testing wire bonds; cleaning bond pads to improve bondability and reliability; and solving cratering, bond fatigue and other mechanical problems.

The book also provides contemporary details such as bonding to multichip modules, utilizing fine pitch bonding, applying new bonding metallurgies and a description of the wire bonding mechanism. The new edition is a volume in the McGraw-Hill series on Electronic Packaging and Interconnection.

For information on how to order his book, contact George G. Harman, B344 Technology Building, NIST, Gaithersburg, MD 20899-0001.

STRESS, STRAIN EFFECTS ON ENERGY STORAGE SYSTEM DEFINED

Superconducting magnetic energy storage units planned by electric utilities will require large quantities of thermal stabilizer to protect the superconductor. One design calls for a niobium-titanium-copper cable to be stabilized with a high-purity aluminum jacket and structurally supported with a high-strength aluminum alloy overwrap. High-purity aluminum has lower electrical resistivity at liquid helium temperatures than a copper stabilizer, and its density is lower, resulting in reduced magnet size and mass. However, the cable will be subjected to stress and strain during normal operation as power system requirements change.

To study these effects, NIST scientists tested aluminum-composite test rings from high-purity aluminum and high-strength aluminum alloy. Magnet operating conditions were simulated. One test subjected a composite ring to fatigue at 4 K with the peak hoop stress held constant and the ring's electrical resistance periodically measured. A second fatigue test held the peak hoop strain constant. In both tests, the initial peak strain was 0.21 %. In the constant-strain test, the increase in resistivity after 4000 fatigue cycles was 40 % greater than for the constant-stress test, indicating a significant strengthening of the composite through work hardening of the aluminum.

These results allow for a substantial reduction in the required quantity of high-purity aluminum stabilizer and, therefore, in the cost for magnets.

A paper, no. 40-97, describing this work, is available from Sarabeth Harris, MC 104, NIST, Boulder, CO 80303-3328.

TESTS SHOW FOAM PROTECTS HOMES IN FIRE STORM PATH

During a wildland or urban fire storm, people often try to save their homes by constantly spraying them with water. Sometimes the attempt works. Sometimes it costs them their lives. NIST researchers hope that a better—and less risky—solution is the application of water-based foam sprays or gels to home exteriors.

In a recent experiment, the NIST researchers demonstrated that a protein-based compressed air foam can protect building exteriors from ignition. They built two wooden, L-shaped frame walls and covered both with exterior vinyl siding. One hour before ignition, the corner of one wall was treated with the protective foam, also called a durable agent. The second wall's corner received no treatment. Both corners were exposed to a 50 kW fire for 10 minutes.

Within 3 minutes of ignition, the untreated corner had flames extending into the eaves and roof area. After 10 minutes of fire exposure, the treated corner had received only minor damage. The fire did not spread on the treated corner.

The experiment demonstrates that applying durable agents to combustible exterior siding reduces the likelihood of ignition and flame spread. The researchers now intend to look at the effectiveness of foam and other durable agents under hot, dry, and windy conditions.

For technical information, contact Daniel Madrzykowski, A345 Polymer Building, NIST, Gaithersburg, MD 20899-0001, (301) 975-6677, <daniel.madrzykowski@nist.gov>.

NIST INVENTION HAS "POLISH"

Evaluating the capabilities of a versatile, NIST-invented technology for lapping and polishing high-precision parts will be one of the initial tasks of the University of Delaware's Center for Nanomachined Surfaces. A private company that is a major supplier of surface finishing products recently licensed NIST's "rapidly renewable lap," or RRL. The company will make the technology available to the new center. There, researchers from the private compnay, the University of Delaware, NIST, and six other organizations are teaming up to improve methods for polishing photomasks the intricately stenciled quartz plates used to print ever finer and ever more complex circuit patterns on computer chips.

The RRL consists of a porous ceramic form, which imparts its shape and texture to a vacuum-applied, thin film that carries abrasive particles. Ceramic substrate, overlying thin film and abrasive can be tailored to a particular task or workpiece, such as a photomask, silicon wafer, or magnetic disk. In tests, the system removed material from the surface of glass, silicon, copper, and other workpieces at significantly better-than-average rates, while reliably achieving high-quality surfaces, says the NIST precision engineer who led the development effort. The private company was a key technical contributor.

Potential advantages over current lapping and polishing techniques are the new technology's flexibility and adaptability. Unlike conventional tools, the same system can be used to perform a variety of finishing jobs. For technical information, contact Chris Evans, A117 Metrology Building, NIST, Gaithersburg, MD 20899-0001, (301) 975-3484, <christopher.evans@nist.gov.

FEBRUARY WORKSHOP SEEKS IMPROVED TRADE WITH CHINA

With a quarter of the world's population within its borders, China offers an extremely attractive market for U.S. manufacturers. However, differences between and redundancies in U.S. and Chinese conformity assessment (testing, certification and inspection of product safety and quality) standards present formidable barriers to trade with the Far East giant.

To remove these obstacles and promote standards-related cooperative efforts, the U.S. Department of Commerce, China's Ministry of Foreign Trade and Economic Cooperation, and other Chinese agencies formed the U.S.-China Joint Commission on Commerce and Trade. One of its goals is to hold workshops where representatives from U.S. industry can learn firsthand about Chinese product safety and quality standards from Chinese government regulatory and standards officials. The forums also will provide opportunities to foster harmonization of standards between the two nations.

For manufacturers of potential export products who need to know about Chinese product standards for electrical devices and boilers/pressure vessels, two Commerce Department agencies NIST and the International Trade Administration are co-sponsoring a Feb. 17-18, 1998, workshop at the department's headquarters in Washington, DC.

Expected to attend are senior management officials from a number of Chinese standards and regulatory agencies, including the Ministry of Labor's Safety Quality Licensing Office, the State Administration for Import and Export Commodity Inspection, and the China Commission for Conformity Certification of Electrical Equipment. Also expected to participate are corresponding U.S. organizations such as the American Society of Mechanical Engineers and Underwriters Laboratories Inc.

For registration information, contact Lori Phillips, (301) 975-3881, <lori.phillips@nist.gov, or check the WWW at http://www.nist.gov/public_affairs/confpage/980217.htm. For information on the conference, contact Stanley I. Warshaw, (301) 975-4193 or (202) 482-6418, <stanley.warshaw@nist.gov>, or Lauren Brosler, (202) 482-4431, <lauren_brosler@ita.doc.gov>.

PREDICTING THE TEXTURE OF SHEET METALS BY EMATs

Researchers at NIST have pioneered the concept of using ultrasound via electromagnetic acoustic transducers (or EMATs) to measure the preferred crystalline orientation, known as texture, in sheet metal. A new technical paper from these researchers describes how EMAT techniques can be used to monitor and control the development of a desired texture in the rolling process for copper, brass, and bronze sheet-metal products.

According to the paper, a particular texture can be achieved through an efficient choice of rolling reductions and annealing steps. "Definition of the texture needed to achieve a particularly desirable set of properties in the final product must be left as a proprietary goal for each manufacturer," the researchers state.

Detailed in the paper are the theoretical foundations, experimental techniques, sample preparation and results achieved in the NIST lab.

For a copy of paper no. 44-97, contact Sarabeth Harris, MC 104, NIST, Boulder, CO 80303-3328, (303) 497-3237, <sarabeth@boulder.nist.gov>.

PHILLIPS WINS 1997 PHYSICS NOBEL PRIZE

On Oct. 15, 1997, NIST Fellow William D. Phillips of the Physics Laboratory was informed that he had been selected to receive the 1997 Nobel Prize in Physics "for development of methods to cool and trap atoms with laser light." The prize was officially awarded Dec. 10, 1997, in Stockholm to Phillips, Stephen Chu (Stanford University), and Claude Cohen-Tannoudji (École Normale Supérieure in Paris). Phillips is the first NIST/NBS scientist to receive the Nobel Prize.

Phillips, Chun, and Cohen-Tannoudji were recognized for indpendently developing laser techniques to cool atoms to temperatures just millionths of a degree above absolute zero, and to store the cold atoms in different kinds of optical and magnetic traps. In 1988 Phillips' group at NIST demonstrated laser cooling of atoms well below the predicted lowest attainable temperature. Subsequent studies and analysis revealed unexpected forms of interaction between light and matter. Phillips and other researchers exploit these interactions to manipulate atoms and ions with unprecedented control. A primary application of laser cooling and trapping is improved time standards ("atomic clocks"). The research has opened new fields of study such as atom optics and "atom lasers" and may have future application in the development of extremely sensitive gyroscopes for navigation and production of extremely small electronic components.

NIST researchers continue to pioneer laser manipulation of atoms. Examples in addition to Phillips' work include: unique studies on cooled and trapped ions; studies of gaseous Bose-Einstein condensates; and laser-assisted production of nano-structures.

Phillips, who joined NBS in 1978, is quick to credit his collaborators: "The research honored by this prize is the result of a huge effort by many other people. The vitality of the research environment at NIST and the scientific quality of my group have been essential to what we have accomplished." In addition to his remarkable scientific career, Phillips is known for his community service, enthusiasm, and affability.

Further information is available at the Nobel Prize Web site (http://www.nobel.se/announcement-97/physics97.html) and the Physics Lab home page (http://physics.nist.gov/News/contents.html).

EXPECT

A NIST computer scientist has developed a software package called Expect (Version 5 released March 1994). Expect is a tool for automating interactive UNIX applications such as telnet, ftp, passwd , fsck, rlogin, tip, etc. It also is useful for testing these same applications. Expect makes these applications simple to use and can make easy all sorts of tasks that are prohibitively difficult with anything else. Expect has been described in many books, articles, and papers; in fact, there is an entire book on it. Many companies are using Expect to automate tasks, which ultimately has saved them money. A newly published book Tcl/Tk Tools [ISBN 1-56592-218-2], which describes the most significant 12 extensions for the Tcl community, notes in the foreword that Expect was the first significant Tcl extension and was responsible for the initial crucial interest in the Tcl language.

SOFTWARE DEVELOPMENT FACILITATES DESIGN OF ELECTRONIC PACKAGING SOLDER INTERCONNECT: JOINING CAPABILITIES

NIST scientists and researchrs from private industry and academia are partners in the development of software that facilitates the design of electronic packaging. The software, in the form of enhancements to the public domain software "Surface Evolver," allows designers to determine equilibrium shapes of solder joints and resulting forces on the electronic package leads, given the input of critical physical properties (surface tension, volume of solder, temperature, and position). The calculation of these forces is often important since the

forces exerted by the solder joints pull the chips into final alignment. The software has allowed electronic package designers at one of the private companies to prevent component "fall off" while soldering side two of a two-sided board, improving the yield from 20 % to 90 %. In another soldering challenge, a product suffered from "floating and twisting" of every battery contact during soldering, requiring each contact to be repositioned by hand. Using the software and insights gained from recent meetings, the private company solved this problem as well. The work of the Solder Interconnect Design Team is described on their web page at http://www.ctcms.nist.gov/programs/solder.

ULTRASONICS AND YOUR FUTURE DENTAL CROWN

NIST researchers are using sound velocity measurements of composite materials that are being evaluated for dental crown applications. Knowing the material density, the elastic moduli of the dental crown materials may be determined from the velocity data. It is important to calculate the elastic moduli of the material to determine if a specific material is suitable for a dental crown. Ideally, dental crown material would give slightly under pressure but not too much to be springy. If the material does not give at all, then it is likely to break when the patient bites down. Two materials under consideration are glass-infiltrated alumina and spinel structures. NIST researchers assisted with the ultrasonic measurements of the Young's modulus and Poisson's ratio that are used to assist with finite element and analytical modeling of the Hertzian contact damage response of these structures.

NIST REFERENCE DATA WEB SITE ATTRACTS WIDE INTEREST FROM INDUSTRY

Since its public release in August 1997, the Statistical Reference Datasets (StRD) Web site has been accessed by dozens of information technology companies. Users of mathematical and statistical software also have used the new Web site, which provides certified test data and results for assessing the numerical accuracy of statistical software. StRD now includes 58 datasets in four statistical areas.

Responses to the new Web site have been universally favorable. One user described the StRD Web site as "the most exciting thing since the Longley Benchmark." The site may be accessed at http://www.itl.nist.gov/div898/strd/.

INCORPORATION OF THERMAL RADIATION IN LARGE EDDY FIRE SIMULATIONS

Researchers at NIST have developed a model of thermal radiation for use with their large eddy simulation (LES) approach for fires. The LES technique is a computationally efficient method for simulating fires in which the resources of the computer are applied to resolving the buoyancy generated motion of hot gases and smoke. Thermal radiation is a very important component in fire dynamics. Radiation to the fuel bed and to flammable objects surrounding a fire can result in the formation of volatiles and their subsequent ignition. This process has many practical implications such as a minimum spacing between buildings to reduce the chance of fire spread. Of current concern is the role of thermal radiation in warehouse fires involving stacked boxes.

NIST PROVIDES KEY SERVICES TO AAMA EVALUATION OF REVERBERATION CHAMBERS FOR VEHICLE IMMUNITY TESTING

Two NIST scientists have provided special technical assistance that made possible meaningful measurements by participants in the American Automobile Manufacturers Association (AAMA) project to evaluate the use of electromagnetic reverberation chambers for vehicle immunity testing. Without the NIST contribution, tests at the reverberation chamber at the Naval Surface Warfare Center, Dahlgren Division, would have resulted in identifiable vehicle system failures, but there would have been minimal knowledge of the magnitudes of the electromagnetic fields that produced the failures. Unlike the NIST reverberation chamber, the Dahlgren chamber is large enough to accommodate full-size automobiles. The manufacturers are concerned that electromagnetic interference will cause vehicle systems to malfunction or fail. The increasing use of electronics in systems critical for safe vehicle operation contributes to these concerns. In addition to participation by NIST and the Navy, the AAMA project team consists of representatives of the three major auto manufacturers.

In addition to providing overall technical guidance, the NIST scientists calibrated the chamber, conducted electromagnetic field mapping measurements in it, and analyzed field measurement data. These measurements made it possible to quantify the loading effects of the vehicle and to study the field distributions at selected locations in and around the vehicle during exposure. The exposure data then were correlated to specific vehicle failures experienced and recorded during the exposure. Preliminary analysis of the data indicates that the

reverberation chamber is an effective technique for determining vehicle vulnerability to electromagnetic fields and may be more thorough than current methods. The AAMA plans to conduct additional experiments to estimate repeatability and uncertainties in measurements at a single chamber and at chambers having different configurations, and to develop specific measurement procedures for vehicle tests.

NONLINEAR DYNAMICS MODELS FOR HIGH-SPEED MACHINING

High-speed machining processes are increasingly important in modern manufacturing. However, such processes can lead to discontinuous chip formation that is strongly correlated with increased tool wear, degradation of the workpiece surface finish, and less accuracy in the machined part. NIST is developing a new approach to modeling some high-speed machining processes that has the potential to predict the onset of discontinuities.

NIST scientists treated some basic metal cutting operations as nonlinear dynamical systems that include a mechanism for thermomechanical feedback in the region where the tooltip and workpiece material are in contact. The resulting mathematical models share many similarities with models of open chemical reactors. In a paper published in the Annals of the C.I.R.P. (International Institution for Production Engineering Research), NIST scientists showed that, as the cutting speed is increased, a bifurcation from steady-state to oscillatory behavior occurs in computer simulations of the model, which is consistent with the change from continuous to segmented chip formation.

To obtain an analytical criterion for the material and cutting conditions at which this bifurcation occurs, the researchers developed a related but simpler lumped-parameters model. In a paper in Physical Review Letters, the scientists demonstrated that a Hopf bifurcation provides a dimensionless group of parameters directly proportional to the cutting speed that predicts the onset of discontinuous chip formation and is consistent with experimental observations on hardened steel and copper. Improvements in the models are in progress.

This research provides improved mathematical models for computer simulations of manufacturing processes, which involve high-speed cutting of materials. Industry can use this information to control and improve the machining processes.

NEUTRON RADIOGRAPHY HELPS CHARACTERIZE FUEL CELL OPERATION

NIST scientists are using neutrons to improve understanding of the operation of fuel cells, compact potential sources of low pollution energy. Physicists at NIST use high-resolution neutron radiography as a powerful tool to study details of water transport in operating polymer electrolyte fuel cells (PEFCs).

Fuel cells use chemical reactions to produce large amounts of electrical power without emission of pollutants and show great potential as alternative power sources for use in electrical generating plants, locomotives and automobiles, and for other applications. Better understanding of water gradients in the cells is critical to optimizing performance through better modeling, but such measurements had been extremely difficult to make. NIST researchers used a highly collimated, monochromatic beam of neutrons from the Center for Neutron Research reactor to probe humidity distribution in the composite membrane of a PEFC operating under various conditions. The 0.66 mm thick composite membrane of the PEFC was viewed edge on by the neutron beam, giving 0.04 mm resolution across the membrane and showing clear changes in water distribution in response to changes in fuel cell current density and feed gas humidification. The NIST data may be crucial to improved design of future fuel cells.

This work was reported at a meeting of the International Electrochemical Society in Paris in September 1997.

NEW ULTRAVIOLET RADIOMETRY FACILITY AT SURF

The first measurements have been completed with the new ultraviolet radiometry facility at the Synchrotron Ultraviolet Radiation Facility (SURF II) shortly before shutdown of the storage ring for the planned upgrade. The new facility combines a high-accuracy absolute cryogenic radiometer and a high throughput monochromator with the bright SURF source to make absolute measurements of photodetector responsivity, materials transmittance, and other optical parameters in the spectral range from 125 nm to approximately 320 nm.

Researchers at NIST developed, designed, and constructed the new facility to improve NIST ultraviolet radiometry capabilities, which had been limited by lack of appropriate sources and detectors.

The optical system delivers several microwatts of monochromatized radiation to the absolute detector, permitting measurements with a relative uncertainty of about 0.1 %. The facility has been used to measure the absolute spectral responsivity of a wide variety of UV photodetectors, including Si, PtSi, GaN, and diamond. The facility can also measure the spatial uniformity of detector response, absolute internal quantum efficiencies in photodiodes, and UV-induced changes in responsivity. In the future, the spectral range of the facility will be extended down to about 50 nm.

NEW INFRARED SPECTROMICROSCOPE AT SURF

Infrared spectromicroscopy—microscopic examination using infrared light—reveals both chemical and structural details of materials. This technique is used for non-destructive testing, chemical "fingerprinting" of industrial and forensic samples, and basic studies of materials.

NIST researchers are exploiting the often-overlooked infrared (IR) capabilities of synchrotron radiation to improve IR microscopy. Researchers at NIST have installed and tested a new beamline at the Synchrotron Ultraviolet Radiation Facility (SURF II) for IR spectromicroscopy. SURF generates IR light that is two to three orders of magnitude brighter than conventional IR sources such as glowbars. This increased brightness substantially improves the spatial and spectral resolution of IR microscopy.

The beamline includes special optics to collect the IR light from SURF, a Fourier transform infrared (FTIR) spectrometer to monochromatize the light, and an IR microscope using the light from the FTIR. The system operates in the spectral range 1.5 μm to 25 μm.

IMPROVED STABILITY FOR THE AT1 TIME SCALE

The stability of AT1—the basic NIST time scale—has been improved by a factor of two through the addition of higher performance clocks and adjustments of time-scale parameters. Over the past 2 years, NIST researchers have integrated two new hydrogen maser clocks and a new high-performance cesium standard clock into the system of atomic clocks used to realize AT1. The time scale is now realized by combining the readings of seven clocks: three masers and four cesium standards. For optimal performance, the researchers had to develop methods to deal with small long-term frequency drifts in the masers (an issue that does not affect the cesium standards).

Coordinated Universal Time (UTC, disseminated by NIST through radio stations and the Internet) is derived from AT1 and comparison to international time scales. The performance of AT1 is thus critical to all aspects of NIST's work in maintaining and disseminating time and frequency standards. The new AT1 is stable to better than 1×10^{-15} after 10 days of averaging. In addition to continued improvement in the time scale for such applications as global positioning, the improved time scale performance will support higher frequency standards such as the new cesium-fountain frequency standard currently under construction.

ENVIRONMENTAL SENSITIVITIES OF HYDROGEN MASERS

Hydrogen masers are now the major determinant in realizing the primary NIST time scale based on a total of seven atomic clocks. To better characterize the time scale, it is critical to understand the stability of the masers over periods of days to weeks. A NIST researcher has studied maser stability in response to changing environmental factors such as temperature, humidity, atmospheric pressure, electric power voltage, and magnetic field. The masers are housed in environmental chambers permitting changes in temperature and humidity; voltage and magnetic field variations also can be accomplished. However, studies of pressure effects required construction of a special pressurized environmental chamber that still maintains tight control of temperature and humidity.

The researcher found that variations in voltage, humidity, pressure, and magnetic field of the magnitude expected in normal operation perturbed the maser frequency by less than 1×10^{-16} over 20 days, having no appreciable impact on the time scale uncertainty. But chamber temperature fluctuations on the order of 50 mK produced drifts of 3×10^{-16} in the same period, which does contribute noticeably (a few percent) to the overall time scale uncertainty. The researcher concludes that very careful attention must be devoted to stringent temperature control as NIST continues to improve its time scale realization.

IMPROVED INTERNET TIME DISTRIBUTION

The NIST Internet Time Service receives more than 2 million requests for service daily to automatically set internal computer clocks. A NIST researcher has substantially improved the client software users employ to receive the time signals from the 10 servers operating in Boulder, CO and the east and west coasts.

The new software uses the so-called interlock method to better estimate the time required for the signal to travel from the server to the client over the varying Internet paths. The interlock method permits synchronization to within about 1 ms over long network paths and to within about 100 ms over short paths. However, optimal performance requires some manual tuning by the user. The researcher is developing an even more powerful method called autolock, which will automatically characterize performance of the local user clock and the network delay with no user intervention. This autolock software, undergoing preliminary testing, will provide near optimal performance in a manner transparent to the user.

NEW SPECTRAL OBSERVATIONS USING LASER MAGNETIC RESONANCE (LMR)

NIST researchers are using the extremely sensitive technique of laser magnetic resonance (LMR) spectroscopy to accurately measure the frequencies of atomic and ionic lines for use in fundamental studies. LMR probes atoms and molecules by observing how they absorb and emit radiation in magnetic fields. NIST researchers collaborated with Oxford University researchers to study the fine-structure line frequencies in Al, F^+, and Fe^+, obtaining the first measurements of the hyperfine parameters for these atoms. They also measured the fine-structure line frequencies for the molecule FO, which involve very weak magnetic dipole transitions extremely difficult to observe by other methods. The success in observing the FO lines strongly indicates that LMR will be very useful for observing such weak transitions in other molecules important to remote sensing and industrial applications.

NEW FAR-INFRARED LASERS LINES

NIST scientists have characterized more than 30 new far-infrared laser lines that will extend the range of the extremely sensitive laser magnetic resonance (LMR) spectroscopic technique. Two NIST scientists collaborated with scientists from Brazil, Japan, and Canada to discover the new gas laser lines in hydrazine, difluoromethane, and methanol in spectral regions where very few lines for LMR were known previously. These new laser lines should improve the use of LMR to measure important transitions in molecules in the upper atmosphere and in space, important for understanding the Earth's climate and energy budget.

More than 20 new lines were observed for $^{13}CH_3OH$ (methanol), 20 far infrared lasing transitions were discovered in difluoromethane species ($^{12}CH_2F_2$ and $^{13}CH_2F_2$), and 14 new transitions were found in hydrazine (N_2H_4). The hydrazine observations are especially noteworthy since only six hydrazine laser transitions had been known previously.

HIGH TEMPERATURE SUPERCONDUCTING MATERIALS DATABASE NOW ACCESSIBLE ON THE WORLD WIDE WEB

NIST has implemented the PC version of the NIST Standard Reference Database on High Temperature Superconducting Materials on the World Wide Web (WebHTS). This database provides evaluated thermal, mechanical, and superconducting property data for oxide superconductors. The range of materials covers the major series of compounds derived from the Y-Ba-Cu-O, Bi-Sr-Ca-Cu-O, Tl-Sr-Ca-Cu-O, and La-Cu-O chemical families, along with numerous other variants of the cuprate and bismuthate materials that are known to have superconducting phases. The materials are described by specification and characterization information that includes processing details and chemical compositions. Tables of numerical data on physical characteristics such as density and crystal structure also are provided. All measured values are evaluated and supported by descriptions of the measurement methods, procedures, and conditions. In all cases, the sources of the data are documented fully in a comprehensive bibliography. Additionally, a comprehensive user's guide is provided. WebHTS is available at http://www.ceramics.nist.gov/srd/hts/htsquery.htm.

PRIMER PUBLISHED ON THE U.S. CERTIFICATION SYSTEM FROM A GOVERNMENTAL PERSPECTIVE

NIST has published a new report, NISTIR 6077, The U.S. Certification System from a Government Perspective, which provides an introduction to some of the complexities of the U.S. certification system from a governmental perspective. The report traces the evolution of authority to regulate products and conduct necessary product assessments from total state responsibility to a shared role between states and the Federal Government. The report discusses the growth and development of U.S. product certification activities in the decades since then.

The report examines the relationship between Federal agencies, state agencies, and the private sector as well as the history and philosophy behind the U.S. system. Readers are encouraged to take advantage of related publications and services offered by NIST, which are described in Appendix I of the report.

ENERGY-RELATED INVENTIONS PROGRAM MAKES RECOMMENDATIONS

NIST recently recommended four innovative technologies for support to its Department of Energy partner under the Energy-Related Inventions Program:

Single Device Equivalent to a Complimentary Metal Oxide Semiconductor (CMOS)—a semiconductor device equivalent (in design) to a CMOS and the fabrication process for producing such devices. The device replaces back-to-back series N- and P-channel metal oxide semiconductor field effective transistors (MOSFETs) with two back-to-back Schottky barrier diodes.

The 2×4 Drilling and Hoisting System—a patented invention that is a rig for drilling oil and gas wells on land and offshore. The innovation enables the removal of

drill pipes in four pipe sections at a time (fourbles) as opposed to two or three pipe sections in conventional rigs.

Method of Making Steel Strapping and Strip—a continuous process for producing steel strapping of significantly higher quality and lower price than can be attained by conventional production processes. The invention uses rod produced from steel scrap by a mini mill and rolls it directly into steel strapping of the desired width and thickness.

Silicon Semiconductor Wafer Test—a machine that fully automates and speeds up a hand-operated wafer test by several orders of magnitude. The test is used throughout the microchip industry to determine whether a wafer is of acceptable quality or must be rejected due to metal contamination of the wafer surface that occurs during wafer production.

THERMODYNAMICS OF THE CONVERSION OF CHORISMATE TO PREPHENATE

The conversion of chorismate to prephenate, catalyzed by the enzyme chorismate mutase is a rare example of a biochemical Claisen rearrangement. This reaction is central to many of the metabolic pathways being investigated in biotechnology for the manufa cture of aromatic compounds.

Two NIST scientists, in collaboration with scientists at The Scripps Institute and the Universities of Notre Dame and UCLA, have completed an investigation into the energetics of this reaction using microcalorimetry and a monofunctional chorismate mutase enzyme. The enzyme, derived by the Scripps scientists from an engineered host bacterial strain, was devoid of enzymatic activities that could have led to interfering side reactions. The NIST scientists measured the standard molar enthalpy change for the conversion of chorismate to prephanate and were able to set a lower bound for the value of the equilibrium constant for the reaction. The university collaborators used the data to validate a novel and extensive quantum chemical calculation of the enthalpy change that for the first time accounts for the effect of water solvation and solvent polarization. These calculations also provided the absolute and relative energies for chorismate and prephenate both in the gas phase and in aqueous solution. The calculated and measured values of the standard molar enthalpy change differed by only 9 kJ mol^{-1}.

This good agreement between measurement and theory indicates a significant advance in understanding the energetics of this reaction and helps establish a basis for the extension of quantum chemical calculations to other biochemical reactions. From a practical standpoint, these results also may prove useful in understanding why one branch in the pathway leading to the synthesis of aromatic amino acids is favored over an alternative one and to what extent rigorous kinetic control at the chorismate branch point is required to direct metabolic flow. The results of this study will be published in the Journal of Physical Chemistry B.

NEW SENSITIVE SURFACE TECHNIQUE FOR VIBRATIONAL SPECTROSCOPY OF BIOMOLECULAR MATERIALS

A novel spectroscopic system has been developed at NIST that will allow compositional and conformational analysis of thin film materials at smooth metal surfaces. This technique will be used to examine biomolecular materials useful in tissue engineering, pharmaceutical development, and biosensing and permit their study under physiologically and biochemically relevant conditions. The technique involves the use of surface plasmons to excite Raman scattering, coupled with Fourier transform interferometry; thus, it is surface plasmon resonance-enhanced Fourier transform Raman spectroscopy (SPR-FT Raman spectroscopy). Raman scattering allows the identification of molecular components and the assessment of the inter- and intramolecular interactions between molecules. When used in conjunction with surface plasmon resonance kinetic measurements, reactions occurring at a biological interface can be characterized fully.

This technique has been developed as an alternative to surface enhanced Raman spectroscopy that can be used only at a rough surface and that only permits observation of molecules in very close proximity to the surface. Because surface plasmons decay exponentially with distance from the surface, this new technique will allow thicker, multilayered materials as well as monomolecular layers to be examined. Surface plasmons enhance Raman scattering from surface molecules by a factor of 10 000, a result of the enhancement of the electromagnetic field in the immediate vicinity of the surface.

The SPR-Raman optomechanical unit was designed and developed for maximum efficiency of detection. Infrared radiation (1.06 μm) from a Nd-Yag laser is coupled into plasmons at the surface of a gold film through a spherical prism. Raman scattering occurs in 2π steradians at angles close to the excitation angle. A spherical prism allows efficient collection of the scattered light through an ellipsoidal mirror that directs Raman scattered light into the interferometer and detector. Mechanical control of mirrors allows adjustment of the angle of the incident beam for surface plasmon excitation, so that materials with different optical properties can be examined efficiently. The use of light

in the infrared region means less damping of the surface plasmons and reduced absorbance of Raman scattering from the sample, thus enhancing the efficiency of Raman scattering and detection.

TELEPRESENCE MICROSCOPY AND MICROANALYSIS: FIRST DEMONSTRATION

NIST scientists have completed the first demonstration of problem solving using remote microscopy and microanalysis between NIST and a semiconductor company. The company is developing a process for patterning metal thin films on oxidized silicon surfaces. Understanding the morphological evolution of patterned features is the key to a successful process. NIST assisted this understanding by utilizing advanced field emission gun scanning electron microscope (FEG SEM), which has approximately an order of magnitude higher resolution than standard SEMs. The analysis was performed with a scientist from the company, watching real-time several hundred miles away via a World Wide Web link using standard WWW Browser software. A NIST scientist performed the analysis on the FEG SEM at NIST with the company scientist looking "over his shoulder," pointing out significant areas of the sample, and interpreting the images while the NIST scientist provided chemical analyses. The team discovered, imaged, and determined the chemical composition of 100 nm sized contaminants at the metal-silicon oxide interface.

The "live" NIST/industry connection dramatically improved efficiency and customer satisfaction by directly answering significant questions with no wasted time. Sample mailing, reception, and analysis took two days. The analyst learned about the composition of the sample and important areas for analysis while the client got immediate results that were exactly what was needed with no unnecessary analysis, decreased analyst learning curves, and immediate reporting. In microprobe measurements, this analysis typically would have taken two to four weeks for mailing, initial analysis, interpretation, reanalysis, reinterpretation, and final analysis and reporting. This first telepresence microscopy demonstration showed the importance of remote imaging and analysis for attaining successful results rapidly and efficiently.

Although additional work needs to be done, it is believed this mode of operation will be a generic paradigm for information transfer for a broad range of technologies and measurement systems. The information, measurements, and services would range from research results, high technology, state-of-the-art "service analysis," to instrument troubleshooting, repair, and maintenance. It is possible that two or more instruments could be networked together, providing instrument calibration and traceability to national or international standards.

PROVISIONAL PATENT FILED ON ION CURRENT SENSOR

A researcher at NIST recently has filed a provisional patent on a new technique to measure the current of positive ions flowing from a plasma to an electrode. The technique is designed for use in high-density plasma reactors, which are used widely by the semiconductor industry. In these reactors, substrate wafers exposed to the plasma are bombarded by reactive chemical species and energetic positive ions, resulting in the deposition or etching of films. Sensors are needed to monitor the ion current and other relevant properties of the incident ions and neutrals, because these properties often drift as conditions within the reactor change. Such sensors could be used to detect process drift, diagnose its origin, and take corrective action, if needed.

The technique to be patented is designed to measure the ion current at a wafer that is being processed by the plasma. The technique does not require any hardware to be inserted into the plasma reactor, thus avoiding any possibility of contaminating wafers. Instead, the technique relies on measurements of the radiofrequency voltage and current made externally. It does not require the application of any voltage other than the rf bias voltage which is normally applied to wafers during processing, thus avoiding any possible perturbations to the plasma. Because radiofrequency signals are used, the technique can measure ion current even when electrically insulating layers are present on or beneath the wafer. No prior method of measuring ion current shares these advantages.

To determine the ion current, the ion current must be distinguished from the current of plasma electrons collected by the electrode and from the surface charging current, that is, the current of electrons that flow between reactor surfaces in response to changes in the charge density in the plasma. A complete model of all the current mechanisms is not necessary, however. Instead, the ion current is determined using general principles, which do not depend on the gases being used. Comparison with independent, dc measurements of ion current have verified that the technique is valid over the range of bias voltage, bias frequency, and ion current used in commercial reactors. Additional tests showed that even in cases where dc measurements fail (when electrically insulating wafers were placed on the electrode and when an insulating layer was deposited on

the electrode) ion current measurements could be obtained by the new technique. Currently, NIST is seeking licensees to commercialize the technology.

NEW PARTIAL DISCHARGE DETECTION SYSTEM DEVELOPED FOR HIGH-VOLTAGE EQUIPMENT DIAGNOSTIC

A new, digital-detection system for measuring pulsating partial discharges (PDs) has been developed by a NIST scientist. The PD detection system can continuously record all random PD pulses that occur over extended periods of time, with a maximum average pulse rate exceeding 100 kHz, a minimum inter-pulse time resolution of 3 ms, and a vertical amplitude resolution of 12 bit. The PD detection system has several potential applications, including use as a diagnostic tool, under ac or dc conditions, for monitoring and assessing the integrity and remaining life of electrical insulation of high-voltage apparatus; and in quality-assurance testing during the design and manufacture of high-voltage electrical components. Laboratory tests show that the sensitivity of the PD detection system is about 1 pC per pulse. The system's design takes full advantage of the tremendous processing power of the currently available, fast, personal computers and the newly available, sophisticated, data-acquisition boards. The scientist's system differs from NIST's earlier designs, which detected PD pulse amplitude and time with custom-designed hardware. The new system continuously records the complete electrical waveform that carries the PD pulses and extracts, in real time, the time and amplitude information of all random PD pulses in software. The scientist has described the new method, in detail, in the J. Res. Natl. Inst. Stand. Technol. 102, 455 (1997).

This approach for PD detection considerably reduces the development and maintenance cost of a PD detection system, significantly increases the system portability, and may prove to be a crucial step for transferring the digital PD detection and analysis technology developed in laboratories to industry. Currently, the system is being used at NIST to study PD-induced aging of dielectric materials and correlation between stochastic properties of PD pulses and the degree of PD-induced damage on dielectric surfaces. A copy of the new PD detection system also has been made and delivered to the Wright Laboratory, U.S. Air Force Base where it is employed to study and monitor PD-induced degradation of HV components used in aircraft.

NIST ESTABLISHES STATEMENT OF INTENT WITH IRC

NIST and the Institute for Research in Construction (IRC) of the National Research Council of Canada recently signed an agreement to identify areas for collaborations that will increase each laboratory's productivity and effectiveness, improve the performance and economy of constructed facilities, and increase the productivity and competitiveness of the industries of construction. Areas for collaborations include: (1) laboratory, field, and analytical research; (2) measurement and test methods; (3) recommendations for national and international standards; (4) conducting workshops with industry, academia, and government agencies; (5) laboratory visits and exchanges of staff; (6) exchanges of information, and (7) joint planning.

NIST ESTABLISHES STATEMENT OF UNDERSTANDING WITH IBHS

A Statement of Understanding has been established with the Institute for Business and Home Safety (IBHS) to work together in natural disaster mitigation. Joint planning will center on: (1) identifying technologies that can mitigate the impact of natural disasters on people and property; (2) collaborating in hazard assessments that may lead to the development of new technologies, including retrofit applications and advancements in design and construction practices to reduce losses; and (3) developing technologies to assess the structural integrity and safety of buildings and developing economical retrofit methods to improve their resistance to natural disasters.

Both organizations will explore the feasibility of developing databases of natural disaster losses, tools to evaluate hazards, and guidelines and materials for educational and training programs for underwriters and owners to reduce vulnerability natural hazards. NIST and IBHS will develop disaster education and training programs that improve the knowledge of insurance underwriters and practitioners of the design and construction industry.

NIST AND THE NATIONAL SECURITY AGENCY (NSA) FORM PARTNERSHIP IN SECURITY TESTING

At the 20th National Information Systems Security Conference, NIST and NSA announced the formation of the National Information Assurance Partnership

(NIAP), a U.S. government initiative designed to help ensure the security of information technology systems and networks through cost-effective testing, evaluation, and certification programs. The program will foster the availability of objective measures and test methods for evaluating the quality of information technology security products.

In addition, NIAP promotes the development of commercial testing laboratories that can provide the types of testing and evaluation services that will meet the demands of both producers and users. The program should help producers increase the value and competitiveness of their products (in the United States and abroad) through the availability of formal, independent testing and certification. NIAP efforts will help users in both public and private sectors by providing a sound and reliable basis for the evaluation, comparison, and selection of security products.

During the opening plenary of the conference, NIST Acting Director Robert Hebner invited conference attendees to a special technical session that described NIAP goals and activities. An industry panel affirmed they are early adopters of the NIAP vision. Representatives from four security testing organizations announced their readiness to transition from their roles in the NSA-sponsored Trusted Technology Accreditation Program to participate as NIAP laboratories. This level of industry interest and support is encouraging for the nascent NIAP.

The NIAP will develop tools, test methods, and tests for specification-based information technology security products. This means that the security functionality and assurance requirements of a product or system must be formally described or specified. These specifications then form the basis for the development and conduct of tests for the product or for a class of product (e.g., for a firewall, an access control device, or even a network router).

The internationally developed Common Criteria (CC) will be the focus of much of NIAP's work. The CC provides a comprehensive, rigorous method for specifying security functionality and assurance requirements for products (or classes of products), usually in the form of protection profiles (PPs). The CC provides an internationally recognized basis for specifying and testing a wide range of security technology, from components to products and systems.

The National Voluntary Laboratory Accreditation Program (NVLAP) will be the basis for much of the NIAP test laboratory accreditation efforts. Initial NIAP facilities and offices are located at NIST.

For more information, visit the NIAP home page at http://csrc.nist.gov/niap.html.

TWO NEW PRECISION MEASUREMENT GRANTS AWARDED

NIST has awarded two $50 000 Precision Measurement Grants for fiscal year 1998. The recipients, Jens H. Gundlach (University of Washington) and David C. Shiner (University of North Texas), were selected from 25 candidates. The NIST grants promote fundamental research in measurement science in U.S. colleges and universities and foster contact between NIST scientists and the academic community.

The aim of Gundlach's project, "Measurement of Newton's Constant G Using a New Method," is to determine the constant of gravitation with a relative standard uncertainty of less than 10^{-5}. Such a result would represent the most accurate value of this important but poorly known constant ever achieved and would illuminate the cause of discrepancies among current values. The meas-urement will use a rotating torsion balance in an acceleration feedback mode, which should overcome major sources of systematic error in previous experiments. The torsion fiber of the balance does not twist, eliminating the need to know the torsion constant; use of a two-dimensional vertical pendulum eliminates the need to know the dimensions and mass distribution of the pendulum to high accuracy.

Shiner plans to measure the 32 GHz fine-structure interval in the helium atom with an unprecedented relative standard uncertainty of 10^{-8}. His project, "Laser Spectroscopy of the Helium Atom for a Determination of the Fine-Structure Constant," should result in a determination of the fine-structure constant with a relative standard uncertainty of 5×10^{-9} when combined with improved calculations of the interval currently under way. A previous NIST Precision Measurement Grant recipient is one of the researchers working on the calculation.) To reduce significant sources of error, an electro-optic laser modulation technique will be used to directly measure the 32 GHz fine-structure interval in Hz. The improved fine-structure constant value will permit more stringent tests of quantum electrodynamic theory by comparing measurement of the magnetic moment anomaly of the electron with the calculated value.

NIST HOSTS FIRST INTERNATIONAL CONFERENCE ON ATOMIC AND MOLECULAR DATA AND THEIR APPLICATION (ICAMDATA)

Almost 200 scientists from six continents met at the Gaithersburg campus to review atomic and molecular data needs for scientific and industrial applications such as fusion energy research, astrophysics, environmental studies, semiconductor device processing, and new

forms of lighting. Twenty-seven invited talks and approximately 100 poster papers were presented at the conference Sept. 29–Oct. 2, 1997, sponsored by NIST. Presentations addressed measurement techniques and needs for such critical parameters as atomic and molecular energy levels, transition probabilities, and ionization rates. Such data permit scientists to remotely probe physical and chemical properties using the light absorbed or emitted by atoms, ions, and molecules. Such studies are applied to microscopic details of plasmas used in semiconductor manufacturing and to vast interstellar dust clouds. The data also are necessary for accurate modeling of complex interactions between matter and radiation.

A major conference goal was to bring together users and producers of atomic and molecular data to facilitate information exchange and identify the most important areas for new measurements. Conference participants learned about new databases being developed in Japan, Russia, Israel, South Africa, and the United States. NIST has long been a world leader in production and dissemination of atomic and molecular databases. Conference organizers plan to continue the highly successful ICAMDATA biannually.

NEW NIST-INDUSTRY CONSORTIUM FOCUSES ON OPTICAL PROPERTIES OF MATERIALS

NIST and industry have joined forces in the NIST Optical Properties of Materials Consortium to address critical needs in U.S. industry for high-accuracy optical measurements, new standards development and critical evaluation and dissemination of existing optical data. The Consortium, established by NIST is open to North American corporations, organizations, academic institutions, and government agencies.

Optical properties of materials such as ultraviolet to infrared transmittance, reflectance, absorptance, light scattering, and refractive index are critical to production and characterization of devices and materials across a wide range of industries, including communications, semiconductor manufacture, and optical components. The consortium will help identify which optical measurements are needed most and which agencies and industries can provide the required data, improving the services NIST provides to its customers.

WORKSHOP ON HIGH RESOLUTION COLD NEUTRON SPECTROSCOPY

A Workshop on High Resolution Cold Neutron Spectroscopy, jointly sponsored by the National Science Foundation and NIST, was held at NIST in August 1997. The meeting included lectures and hands-on demonstrations at two of the neutron scattering instruments. About 40 people attended the lectures, but the number of participants at the hands-on sessions was limited to 24 to promote maximum partici pation and benefit. Most of the attendees were graduate students, but postdoctoral students, university professors, and scientists from government and industry also were present. The participants represented a wide variety of disciplines, including physics, materials science and engineering, chemistry, molecular biophysics and biochemistry, chemical engineering, and nuclear engineering.

The purpose of the meeting was to introduce participants to the basic principles and techniques of neutron inelastic scattering, emphasizing the types of research that can be undertaken using the instruments at the NIST Cold Neutron Research Facility that use long wavelength (cold) neutrons to achieve high energy resolution. These instruments are the back-scattering, spin-echo, disk chopper time-of-flight and spin polarized inelastic neutron scattering (SPINS) spectrometers. They offer U.S. scientists and engineers a wide range of new research opportunities in virtually all areas of materials research. The lectures and hands-on demonstrations, at the SPINS spectrometer and the medium resolution Fermi chopper time-of-flight spectrometer, were targeted at those with little or no previous experience with neutron inelastic scattering methods. Most of the talks were given by scientists from NIST and nearby institutions. The final day of the meeting was highlighted by presentations from internationally recognized experts who described opportunities for spectroscopic research using cold neutron instruments.

STANDARDS FOR TESTING OF FIBER-MATRIX INTERFACE IN COMPOSITES

Working with researchers at Michigan State University, NIST researchers have developed an international program to develop standards for testing fiber-matrix adhesion in polymer composites under the auspices of the Composites Technical Working Group of VAMAS, an international organization that promotes pre-standards research. Numerous test methods have been developed to quantify this adhesion owing to the critical dependence of the performance of composites on the integrity of bonding between reinforcement fibers and matrix. Because there are no standards for these tests, however, results obtained by different laboratories using the same method can vary widely.

The new program will focus initially on a test procedure called the single fiber fragmentation method, but

may extend to other methods later. The program has three tasks. The first will develop consensus procedures for sample preparations and testing. The second task will conduct a round robin using the recommended test procedure and a common set of samples. This will eliminate variability in sample preparation, widely viewed as a major source of laboratory-to-laboratory discrepancies. The final task will take advantage of the communications established among the participants to provide a forum for identifying critical research issues, exchanging results, and encouraging cooperation among researchers active in the area. Consequently, the final results of the program will include not only a detailed test procedure but also guidelines for future research in the area. Currently, 17 laboratories representing eight countries have agreed to participate in the program.

NIST CONFERENCE HELD ON "USING VOLUNTARY STANDARDS IN THE FEDERAL GOVERNMENT"

NIST hosted a conference in September 1997 as part of ongoing efforts to implement the National Technology Transfer and Advancement Act (NTTAA). The NTTAA assigned NIST a leadership role in coordinating standards and conformity assessment activities with federal, state, and local government agencies and with the private sector to meet the needs of U.S. industry in the global marketplace.

The conference focused on Federal agencies that have worked successfully with standards-developing organizations in Federal agency use of voluntary consensus standards. Four panels presented examples of voluntary standards used successfully for procurement and regulation and for meeting future national needs. Panelists also described the impact of particular standards on agency goals, the process of developing the voluntary standards, and problems that had been encountered.

The conference was attended by more than 200 participants, including representatives from eight major standards developing organizations and from Federal agencies working with the private sector to develop mutually beneficial standards, resolve policy issues, and use standards for federal procurement or regulation.

Overall, the conference fostered better understanding among Federal agencies of the private-sector standardization process and paved the way for increased future collaborative efforts.

NIST AND INDUSTRY WORK TOGETHER TO DEFINE INTEROPERABLE MESSAGE PASSING INTERFACE STANDARD

In September 1997, NIST hosted the third Interoperable Message Passing Interface (IMPI) Workshop to continue work defining the IMPI standard. All major U.S. computer vendors participate in this effort. Representatives of these vendors as well as representatives from the embedded computing community were present to continue this work.

Discussions of the current draft IMPI document included an overview of interoperability and chapters on startup, the MPI connection server, and the data transfer protocol. Chapter authors presented their work and the group agreed that implementation of IMPI by the vendors would go on in parallel with the standard definition in order to get the most information on the choices made. The release of the first standard, IMPI-1, is expected by December 1998.

The group agreed to invite foreign vendors to future meetings. As a representative of the U.S. government, NIST does not vote at these meetings but takes the role of facilitator.

NIST AND NSA COLLABORATE ON FIREWALL PROTECTION PROFILE

NIST and NSA co-sponsored an open workshop recently on the Firewall Protection Profile. The protection profile specifies the minimal essential security requirements for a broad class of firewall devices, ranging from simple packet filters to application gateways. Workshop objectives included reviewing responses to a July 15, 1997 request for comments on the public release draft of the profile, giving the status of NIST's analysis and initial positions on critical areas, and obtaining feedback from workshop participants. The workshop was well attended with representation from vendors having significant market share in the firewall product area, testing laboratories, and the user community.

The firewall profile is one of the first security specifications constructed according to the Common Criteria that has gone through a public review process. The workshop resulted in a consensus on resolution to problems identified with the profile and also to problems inherent with the Common Criteria itself. Plans call for a new version of the profile incorporating workshop results by the end of 1997. Common Criteria

Observation Reports, suggesting corrections to the Common Criteria, also will be issued by then. Problem resolution of both profile and criteria is an important benefit from the workshop, since they form the basis for product evaluations in test laboratories being established by NIST and NSA under the National Information Assurance Partnership.

NIST FOCUSES ON JAVA CONFORMITY ASSESSMENT

Conformity assessment related to the Java specifications was the topic at the Workshop for Conformity Assessment for Java™ held at NIST in September 1997. (TM: Java and Java-based marks are trademarks or registered trademarks of Sun Microsystems, Inc., in the United States and other countries.) Co-sponsors of the workshop included NIST, the IEEE Computer Society, and the Defense Information Systems Agency's Center for Standards. Twenty-eight attendees participated in the workshop.

The workshop provided an open forum for all interested parties to present current conformity assessment efforts, discuss possible testing philosophies and methodologies for the varying Java technologies, and formulate a direction forward. The workshop identified current testing tools and certification programs as well as areas of research and market-need that are not being addressed currently. NIST has initiated a Java conformance testing project to address these areas. Webspace devoted to Java Conformity Assessment is http://www.nist.gov/itl/897/java.htm.

Standards and conformity assessment methods for Java-based products will help vendors produce high-quality products that users can trust.

NIST WORKSHOP ON THE EXCHANGE OF DIMENSIONAL INSPECTION INFORMATION HEAVILY ATTENDED BY INDUSTRY

Representatives of 19 industrial companies gathered together with NIST scientists for the Third NIST Workshop on Modeling and Standards for the Exchange of Dimensional Inspection Information in September 1997, at the National Center for Manufacturing Sciences in Ann Arbor, MI. The industries represented included auto-motive, aerospace, heavy equipment, defense, dimensional measurement systems manufacturers, and software application developers. The workshop continued the important industry engagement in the process of developing a Standard for the Exchange of Product Model Data (STEP) Application Protocol for the exchange of dimensional inspection information throughout an enterprise.

Workshop attendees listened to presentations by NIST staff on the STEP standardization process and the marriage between the inspection and computer domains. In addition, industry representatives worked on developing and validating inspection domain information models, defining terms and concepts in the models, and approved a draft preliminary work item. This draft version was submitted to ISO (International Organization for Standardization) at their Florence, Italy, meeting at the end of October 1997. The excellent industry participation in this effort is continuing in the virtual world by e-mail and soon by a web page and web-based discussion group.

INTELLIGENT SYSTEMS AND SEMIOTICS (ISAS'97) CONFERENCE

NIST hosted the third in a series of annual conferences on intelligent systems at NIST in Gaithersburg, MD, September 1997. The conference was co-sponsored by the Institute of Electrical and Electronics Engineers (IEEE) Control Systems Society, the National Science Foundation, and the Army Research Office. The theme of this year's conference was "A Learning Perspective," with papers presented by a broad cross-section of international researchers representing fields as diverse as biomedical research and cognitive reasoning to evolutionary programming. The conference was preceded by a day of tutorials on semiotics (the science of signs and symbols), the NIST real-time control system (RCS) intelligent reference architecture, and hierarchical modeling and understanding via algebraic automata theory. The conference had an attendance of 105 people, with 36 people attending the tutorials.

The next conference in this series will be hosted at NIST in Gaithersburg and is being planned as a joint conference on the science and technology of intelligent systems. It will incorporate the IEEE International Symposium on Intelligent Control, IEEE International Symposium on Computational Intelligence in Robotics and Automation, and Intelligent Systems and Semiotics (ISIC/CIRA/ISAS'98) and will be held at NIST on Sept. 14 -17, 1998.

"REFRIGERANTS FOR THE 21ST CENTURY" CONFERENCE HELD AT NIST

Refrigerant options for air-conditioning and refrigeration industry in response to ozone depletion and climate change were the topic of the third refrigerant conference jointly organized by the American Society of Heating, Refrigerating and Air-Conditioning Engineers and NIST. The conference, entitled "Refrigerants for the 21st Century," was held in October 1997, at NIST

Gaithersburg. Although the first two conferences organized in 1989 and 1993 were related to ozone depletion, the latest conference included global warming considerations on refrigerant selection. The climate change is becoming the next global environmental problem. The parties to the U.N. Framework, Convention for Climate Change held its third meeting in Kyoto, Japan, in December 1997, to negotiate global preventive measures.

Conference participants were addressed by 16 international experts. The conference provided a forum for presenting different points of view on the best refrigerant options for the future. The need for this dialog will increase as a result of intensifying international climate change negotiations.

NIST HOSTS THIN-FILM METROLOGY WORKSHOP

NIST recently hosted the Thin Dielectric Film Metrology workshop to provide a forum for discussions of thickness measurements of thin dielectric layers, especially measurements based on optical methods, as applied in the semiconductor industry. Organized and led by NIST scientists, the workshop provided a vehicle for soliciting industry views on the role of NIST in promoting reliable measurements of ever thinner films, the evolution of the present set of Standard Reference Materials, and mechanisms for providing traceability to NIST other than the direct sale of SRMs.

Related goals included strengthening and focusing the dialog between NIST and the segments of the semiconductor industry that require traceability of thin-film measurements to NIST and acquainting attendees with the standards and measurement assurance programs that NIST currently supports. In particular, the semiconductor industry depends on the measurement of the thickness of thin films of silicon dioxide to control the thickness of gate oxides as continued reductions in size of integrated-circuit field-effect transistors are pursued.

The workshop was organized in three sessions. In Optical Metrology Techniques and Modeling, speakers focused on issues pertinent to the setup and calibration of optical metrology tools (primarily ellipsometers and reflectometers). The other sessions were Using Standards and Traceability from a NIST Prospective. Participating were manufacturers of optical metrology tools and secondary standards, representatives from IC manufacturers' calibration laboratories, industrial and university researchers, and NIST staff associated with traceability programs.

With respect to developing planning guidance for the NIST Thin-Film Metrology Project, participants in the workshop identified issues that should be addressed promptly, including differences in computational algorithms, cle aning of samples, and long-term stability of oxide thickness in reference artifacts. Issues identified as longer term included the NIST response to gate dielectric projections at the nodes of the National Technology Roadmap for Semiconductors and correlation of nonoptical metrology with optical metrology for thin films.

PHILLIPS RECOGNIZED BY CONGRESS

On Oct. 31, 1997, Commerce Deputy Secretary Robert Mallett, invited by the House Committee on Science (Sensenbrenner, R-Wis., chairman), introduced William Phillips, NIST Physics Fellow, and his Nobel Prize winning work to the Congress. The Science Committee invited all Members of the House of Representatives and the Senate, and especially the Members of Commerce's Authorization and Appropriations Committees (the House Committee on Science, the Senate Committee on Commerce, Science, and Transportation, and the House and Senate Appropriations Committees), as well as interested members of the media, to attend.

House Science Committee Chair James Sensenbrenner, Ranking Minority Member George Brown, Subcommittee on Technology Chair Connie Morella (who also is Phillips' Representative), and Representatives Vernon Ehlers, Eddie Bernice Johnson, Sheila Jackson Lee, and Roscoe Bartlett made brief remarks. Representative Morella stated her intention to hold a similar event in Maryland in the near future. Deputy Secretary Mallett introduced Phillips to the Members, and Phillips gave a brief talk explaining the work that won him the 1997 Nobel Prize for Physics. After Phillips' presentation, Members had an opportunity to ask questions.

NIST SCIENTISTS GIVE KEYNOTE LECTURES AT ASIA PACIFIC METROLOGY SYMPOSIUM

Two NIST scientists attended the Asia Pacific Metrology Symposium (APMS) in Singapore in September 1997. Along with representatives from several U.S. corporations and from national standards laboratories of other countries, speakers focused on improving metrology and establishing parity between nations. The NIST scientists presented talks on the SI units, national traceability, electrical calibrations, and basic methods for calculating uncertainties in calibration procedures.

The APMS was organized by several U.S. corporations and the Federal Aviation Administration as part of an effort of the National Conference of Standards

Laboratories. In addition to speakers from U.S. corporations and agencies, about 150 people attended the symposium from countries in the Asia Pacific Metrology Program. The APMS membership draws researchers from southeast Asia in its entirety, China, Egypt, South Africa, Pakistan, India, Japan, and South Korea. All of the participants valued the symposium and were clearly interested in improving calibration capabilities and establishing standards for international traceability and accreditation.

NIST SEEKS DATA ON SOFTWARE FAILURES

Developing top-quality software—no simple task—is made more vexing by the lack of unified data detailing the pitfalls other software developers and users have experienced. To fill this void, NIST is collecting and analyzing error, fault and failure data from the development, maintenance and operation of software products to build a reference database. Once fully populated, this database can be used by the information technology industry to develop better software by improving the ability to measure the quality and effectiveness of their methods, tools and products.

NIST researchers seek participants to contribute data from software projects and from systems in service to populate the error, fault and failure database, which will allow other organizations to prepare baseline analyses useful for comparing their own development standards to the industry as a whole. Software and system information will be used to derive fault profiles and statistical analyses. All will be made available over the Internet. To protect industry data, NIST can make nondisclosure arrangements with each contributing organization.

NIST researchers have developed the EFFective Manager Tool (known as EFFTool), a free Web-based software tool to aid in the collection and analysis of fault and failure data discovered during the development or maintenance of software. The tool enables a company to track the status of faults and failures and to perform various computations on the data.

For further information, contact Dolores Wallace, Building 820, Room 517, NIST, Gaithersburg, MD 20899-0001, (301) 975-3340, fax: (301) 926-3696, <dwallace@nist.gov>, <http://hissa.nist.gov/toolkit/eff.html>.

AGENCIES LAUNCH TECHNOLOGY ROADMAP EFFORT

NIST and three other Federal agencies have launched a 1-year effort to develop "integrated manufacturing technology roadmaps" (IMTR) that will help to guide their research investments. The IMTR, a priority-setting refinement of the next generation manufacturing project completed earlier this year, will define long-term technology needs in four high-impact areas: information systems, modeling and simulation processes and equipment, and enterprise integration.

In addition to NIST, sponsors of the new strategic initiative are the Defense Advanced Research Projects Agency, Department of Energy and National Science Foundation. Through industry surveys and other methods, the agencies aim to anticipate the tools and capabilities that will be essential to superior manufacturing performance and capabilities over the next 5 to 15 years. A questionnaire focusing on information technologies for manufacturing has been posted on the World Wide Web (http://www.epm.ornl.gov/~mox/cgi-bin/imtr.html), and it is being distributed to a cross-section of organizations and manufacturing leaders. Surveys specific to the other three technology areas are in the works.

The sponsors aim to deliver four integrated roadmaps that provide a shared perspective for investing in long-term technology development. It will identify major technology needs and challenges cutting across industrial sectors. Details of the roadmap will be the basis for crafting government/ industry R&D agendas, and they will enable companies and industries to ascertain whether these agendas respond to their technology requirements.

A status report on the IMTR will be given at the annual National Manufacturing Technology Conference, to be held at NIST's Gaithersburg, MD, headquarters on April 21-22, 1998.

For more information, contact Mark Luce, NIST, (301) 975-2159, <mark.luce@nist.gov>, or Richard Neal, DoE's Oak Ridge Centers for Manufacturing Technology, (423) 574-1862, <nea@ornl.gov>.

NIST HELPS BETTER CHARACTERISTICS LF ANECHOIC CHAMBERS

Semi-anechoic and fully anechoic chambers are facilities commonly used by U.S. manufacturers for demonstrating compliance (with both domestic and international regulations, as well as requirements for interference and susceptibility) of their electronic products. The number of these low-frequency (20 MHz to 1 GHz) electromagnetic test facilities has been increasing steadily during the past decade. However, a major problem in their use has been the time-consuming and difficult task characterizing and verifying their performance.

To solve the problem, NIST has developed new procedures for characterizing low-frequency anechoic chambers. The NIST method centers on a new chamber figure-of-merit based on the decay time of the chamber. This decay time in turn is based on the average reflection coefficient of the energy incident on thechamber walls. Implementation of the new technique avoids labor-intensive measurements and eliminates complex, intensive, time-consuming and, therefore, costly numerical analysis by making use of simplifying approximations that can be shown not to affect the utility of the result. It also enables assessment of chamber performance by means of a single parameter, a significant improvement over existing methods (which have a strong dependence on setup and instrumentation).

Another procedure, for relating chamber figure-of-merit to chamber capability for supporting specific tests, is under development.

Papers (nos. 42-97-A and 42-97-B) describing the work are available from Sarabeth Harris, MC 104, NIST, Boulder, CO 80303-3328, (303) 497-3237, <sarabeth@boulder.nist.gov>.

CONSORTIUM SEEKS BETTER MEASURES FOR EMERGING INDUSTRY

A new NIST consortium on Brachytherapy Manufacturing Technology aims to root a budding healthcare industry in a solid measurement base. Now enlisting members, the consortium will focus on the complex technical needs of manufacturers of tiny radioactive "seeds" used to treat cancer patients and, more recently, to prevent recurring blood-vessel blockages in people who undergo angioplasty or other artery-clearing procedures.

In the still-experimental heart therapy, a catheter is inserted into treated arteries, which are briefly exposed to the radioactive seeds. Confined to a range of only a few millimeters, doses of ionizing radiation have been shown in clinical trials to inhibit the formation of scar tissue that can eventually obstruct blood flow, a problem for 30 % to 40 % of angioplasty patients. NIST and its partners will devise and evaluate automated tools to support designing, producing, and calibrating the radioactive seeds. NIST-developed modeling and simulation software for calculating the distribution and absorption of radiation doses will be extended and incorporated into "expert" computer systems that manufacturers can use to evaluate designs of new radiation sources.

The consortium also will create standard reference materials for ensuring the accuracy of measurements made during production. In addition, plans calls for building an automated calibration system for pre-shipment inspections of final products. Work will be based at NIST's National Advanced Manufacturing Testbed. The NAMT is a state-of-the-art computing and communications testbed where industry, university, and government collaborators are developing the infrastructural technologies necessary for U.S. manufacturers to fully realize the performance advantages enabled by modern information technology.

For more information, contact Christopher Soares, C229 Radiation Physics Building, NIST, Gaithersburg, MD 20899-0001, (301) 975-5589, <christopher.soares@nist.gov>. Also, check out the project page on the World Wide Web at http://www.mel.nist.gov/namt/projects/physics/rad1.htm.

Standard Reference Materials

NEW STANDARD IS FREEZE-DRIED WHAT?

To monitor the health of our oceans, scientists must be able to measure a variety of pollutants that seep into waterways, are absorbed by marine life and passed up the food chain. Since pollutants can become concentrated in mollusks, NIST scientists chose mussels from Dorchester Bay in Boston Harbor for a new Standard Reference Material to help marine biologists accurately assess pollution in marine life.

The mussel tissue SRM includes one 8 g bottle of freeze-dried mussel tissue blended into a very fine powder, plus NIST-certified values for 14 polycyclic aromatic hydrocarbons, 24 polychlorinated biphenyls, seven chlorinated pesticides, mercury and methylmercury. Scientists studying pollution in living tissues can use this SRM to check the accuracy of their own measurement methods. Several international standards laboratories assisted in certifying the pollutant levels in the mussel tissue.

NIST SRM 2974, Organics in Freeze-Dried Mussel Tissue, is available for $411 from the Standard Reference Materials Program, Building 202, Room 204, NIST, Gaithersburg, MD 20899-0001, (301) 975-6776, fax: (301) 948-3730, <srminfo@enh.nist.gov>.

IRISH/OLD BAY COMBO HELPS LABORATORIES ASSESS OCEAN RADIOACTIVITY

Sediment dredged up from the Irish Sea and the Chesapeake Bay has been blended to create a new NIST Standard Reference Material (SRM) for radioactivity. This is the first standard for laboratories that monitor radioactivity in ocean sediment or similar environmental samples.

NIST worked with the United Kingdom's National Radiological Protection Board to prepare and blend the sediments into a very fine powder. Twenty laboratories around the world then assisted in determining the certified levels of radionuclides in the SRM. This international effort was prompted by the need to accurately monitor radiation in Arctic Ocean beds where several nuclear submarines have been sunk.

Laboratories monitoring radioactivity in the environment will be able to use the new NIST SRM to verify the accuracy of their analyses and methods. Researchers have certified values for 10 radionuclides, including natural and man-made isotopes. Non-certified values also are provided for 11 additional radionuclides.

NIST Standard Reference Material 4357, a unit of which consists of one 85 g bottle of powdered ocean sediment, is available for $431 from the NIST Standard Reference Materials Program, Building 202, Room 204, Gaithersburg, MD 20899-0001, (301) 975-6776, fax: (301) 948-3730, <srminfo@enh.nist.gov>.

HIGHLY ACCURATE GOLD/PLATINUM THERMOCOUPLE THERMOMETERS PRODUCED AND CERTIFIED FOR ISSUANCE AS STANDARD REFERENCE MATERIAL 1749

Gold versus platinum (Au/Pt) thermocouple thermometers are to be issued as Standard Reference Material (SRM) 1749. They have been constructed at NIST and were individually calibrated on the International Temperature Scale of 1990 (ITS-90). This SRM is intended for use as a highly accurate and stable secondary reference thermometer in the range 0 °C to 1000 °C. Each thermometer has Au and Pt wires with a relative uncertainty of 99.999 % purity assembled in a twin-bore alumina tube mounted in a protective silica-glass sheath. The expanded uncertainties ($k = 2$) of the thermometer calibrations are estimated not to exceed the equivalent of 8 m °C in the range 0 °C to 962 °C and the equivalent of 14 m °C in the range 962 °C to 1000 °C. Based on studies at NIST of the stability of Au/Pt thermocouple thermometers, the SRM 1749 thermometers can be expected to maintain their stated uncertainties for at least 1000 h of use in air at temperatures up to 962 °C. Their stability is at least 10 times better than that of industrial platinum resistance thermometers above 550 °C and compares favorably with that of high-temperature standard platinum resistance thermometers (HTSPRTs) above 900 °C. Also, unlike the case for HTSPRTs, small mechanical shocks do not affect the calibration of the SRM 1749 thermometers. This ruggedness, combined with the high accuracy and stability, makes this SRM an excellent choice for critical temperature measurements in a variety of laboratory and industrial applications.

HIGH-PURITY TIN AND ZINC FREEZING-POINT CELLS PRODUCED AND CERTIFIED FOR ISSUANCE AS STANDARD REFERENCE MATERIALS 1747 AND 1748, RESPECTIVELY

Tin and zinc freezing-point cells are now available from NIST as Standard Reference Materials (SRMs) 1747 and 1748, respectively. They were constructed at NIST and they were individually certified for use in providing defining fixed points on the International Temperature Scale of 1990 (ITS-90). The production of these SRMs meets a part of NIST's responsibility for disseminating the ITS-90. These new SRMs have freezing-point temperatures, as defined on the ITS-90, of 231.928 °C (SRM 1747) and 419.527 °C (SRM 1748). The expanded uncertainties ($k = 2$) assigned to the freezing-point temperatures of SRM 1747 and SRM 1748 do not exceed 0.40 m °C and 1.14 m °C, respectively. The freezing points of these two high-purity elements and the triple point of water (0.01 °C) enable calibrations of standard platinum resistance thermometers (SPRTs) from 0 °C to 420 °C, which range also is a part of the calibration of SPRTs from 0 °C to 661 °C, and part of the calibration of high-temperature SPRTs from 0 °C to 962 °C. The certification procedure of each cell included evaluation of freezing and melting curves, immersion profiles of SPRTs in the cells, and direct comparisons with the appropriate laboratory freezing-point reference cell. Further information concerning these two SRMs can be found in SP 260-127.

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Calendar

February 2–3, 1998
NIST DIMENSIONAL SEMINAR

Location: Pasadena Convention Center
Pasadena, CA

Sponsors: NIST and Measurement Science Conference. Audience: All parties interested in dimensional measurements.
Purpose: To present the basic concepts, techniques, and equipment used to make dimensional measurements.
Format: Classroom format, covering the theory and essential elements of the subject.
Topics: Detailed discussion of each component of uncertainty budget and how choices of environment, equipment, standards and procedures affect the quality of the calibration.
Technical Contact: Ted Doiron, NIST, Building 220, Room B113, Gaithersburg, MD 20899-0001, phone: 301/975-3472, fax: 301/869-0822, email: tdoiron@nist.gov. WWW Homepage: http://www.inland.net/msc/nist.html.

February 2–3, 1998
TIME AND FREQUENCY SEMINAR ON PROPERTIES OF OSCILLATOR SIGNALS AND MEASUREMENT METHODS

Location: Pasadena Convention Center
Pasadena, CA

Sponsors: NIST and Measurement Science Conference.
Audience: Representatives from academic, professional, and industrial associations and organizations, government agencies, and other interested individuals.
Format: Classroom format, covering the theory and essential elements of the subject.
Purpose: This seminar focuses on common methods of measuring and interpreting oscillator and clock performance and how these results affect overall system performance.
Topics: Participants will learn the specialized measurement techniques for quantifying frequency stability and spectral purity of an oscillator. An overview of methods of timekeeping and synchronization will follow, along with an introduction to available time and frequency services.
Technical Contacts: John Gerhard, email: john.f.gerhard@boeing.com., Wendy Ortega, NIST, 325 Broadway, Boulder, CO 80303-3328, phone: 303/497-3693, email: ortegaw@boulder.nist.gov. Dave Howe, NIST, 325 Broadway, Boulder, CO 80303-3328, phone: 303/497-3277, fax: 303/497-6461, email: dhowe@boulder.nist.gov. WWW Homepage: http://www.inland.net/msc/nist.html.

February 2–3, 1998
EASY AND NOT-SO-EASY STATISTICAL METHODS FOR UNCERTAINTY ANALYSIS

Location: Pasadena Convention Center
Pasadena, CA

Sponsors: NIST and Measurement Science Conference.
Audience: All parties interested in dimensional measurements.
Format: Classroom format, covering the theory and essential elements of the subject.
Purpose: This seminar focuses on methods for evaluating and reporting measurement uncertainties based on experience with NIST calibration and measurement services.
Topics: Develop a toolbox of statistical techniques for uncertainty analysis, explore the role of measurement assurance in developing and validating uncertainty statements, gain an understanding of how to structure measurement protocols in a manner that will lead directly to uncertainty measures, examine the history and requirements of the ISO Guide to the Expression of Uncertainty in Measurement and its implications.
Technical Contact: Carroll Croarkin, NIST, Building 820, Room 353, Gaithersburg, MD 20899-0001,

phone: 301/975-2849, e-mail: carroll.croarkin@nist.gov. WWW Homepage: http://www.inland.net/msc/nist.html.

February 2–3, 1998

NIST PRESSURE SEMINAR AND WORKSHOP

Location: Southern California Edison Metrology
Westminster, CA

Sponsors: NIST and Measurement Science Conference.
Audiences: Engineers, senior technicians, industrial and other users.
Format: Classroom and laboratory instruction.
Purpose: To attain the highest possible accuracy in pressure measurements through the use of piston gauges.
Topics: Theory of piston gauges, calibration of simple piston gauges, the use of gas and oil piston gauges, cross-float against manometer, controlled clearance piston gauges, and calibration of transducers.
Technical Contacts: Jennifer E. Smith, Southern California Edison Metrology, 7300 Fenwick Lane, Westminster, CA 92683, phone: 714/895-0728, email: smithje@sce.com. William Melendez, Southern California Edison Metrology, phone: 714/895-0701. WWW Homepage: http://www.inland.net/msc/nist.html.

February 9–11, 1998

QUEST FOR EXCELLENCE X

Location: Washington Hilton and Towers
Washington, DC

Sponsors: NIST, American Society for Quality (ASQ), Association for Quality and Participation (AQP), and American Society for Training and Development (ASTD).
Audience: Business leaders from around the world.
Format: Conference, including plenary sessions focusing on the Baldrige Award criteria, and question and answer sessions. Designed to maximize learning and networking opportunities.
Purpose: For business leaders to hear from the 1997 winners of the Malcolm Baldrige National Quality Award—3M Dental Products, Solectron Corporation, Merrill Lynch Credit Corporation, and Xerox Business Services—about their journeys to business excellence and their exceptional business practices.
Topics: The seven categories of the Baldrige criteria: leadership, strategic planning, customer and market focus, information and analysis, human resource development and management, process management, and business results.
Technical Contact: Daniel Barton, NIST, Building 101, Room B635, Gaithersburg, MD 20899-0001, phone: 301/975-3555, email: daniel.barton@nist.gov, WWW Homepage: http://www.quality.nist.gov/qualreg.htm.

February 17–18, 1998

U.S.-CHINA STANDARDS, TESTING AND CERTIFICATION WORKSHOP

Location: U.S. Department of Commerce
H. C. Hoover Building
Washington, DC

Sponsors: U.S. Department of Commerce's International Trade Administration, and the Technology Administration's NIST, in cooperation with U.S. trade associations and standards conformity assessment bodies.
Audience: U.S. manufacturers and engineers interested in exporting products to China. Format: Plenary plus breakout sessions.
Purpose: To assist U.S. businesses interested in exporting products to China. China's agencies to be represented include: China's Minister of Foreign Trade and Economic Corporation (MOFTEC), the State Administration of Import and Export Commodity Inspection (SACI), the China Commission for Conformity Certification of Electrical Equipment (CCEE), and the Ministry of Labor.
Topics: China's requirements for the import of products, e.g., telecommunications equipment, fire alarms, medical devices, medical diagnostic x-ray equipment, electrocardiograph equipment, pacemakers, ultrasonic diagnostic equipment, boilers and pressure vessels, electric tools, audio equipment, appliances for heating liquids, cooking ranges, electric irons, food processors, and computer hardware, etc.
Technical Contacts: Stanley Warshaw, NIST, Building 820, Room 326, Gaithersburg, MD 20899-0001, phone: 301/975-4193, email: stanley.warshaw@nist.gov. Lauren J. Brosler, U.S. DOC, ITA, Room 1015, 14th and Constitution Ave., NW, Washington, DC 20230, phone: 202/482-4431, email: lauren.brosler@ita.doc.gov.

March 3–4, 1998
RANGE CERTIFICATION MEETING

Location: National Institute of Standards and Technology Boulder, CO

Sponsors: NIST and Wright Labs, Wright Patterson Air Force Base.
Audience: RCS community. Format: Presentations and discussions.
Purpose: To inform the RCS community on progress on the RCS measurement range certification project and on the Department of Defense RCS Certification Demonstration Program.
Topics: Measurement assurance/improvement plans (MAP), certification philosophy/procedures, and the RCS certification demonstration program.
Technical Contact: Lorant Muth, NIST, Mailcode 813.08, 325 Broadway, Boulder, CO 80303-3328, phone: 303/497-5646, email: lorant.muth@nist.gov.

March 9–11, 1998
11TH ANNUAL FEDERAL INFORMATION SYSTEMS SECURITY EDUCATORS' ASSOCIATION (FISSEA) CONFERENCE TRAINING AMERICAN WORKERS IN COMPUTER SECURITY

Location: Gaithersburg Hilton Hotel Gaithersburg, MD

Sponsor: NIST.
Audience: Anyone concerned with computer security training issues.
Format: Presentations and exhibits.
Purpose: To help organizations survive in this age of automated information by making their employees and customers aware of the threats, vulnerabilities, and risks associated with using computer resources and train them in appropriate computer security matters.
Topics: Network security primer, network security techniques, INFOSEC education programs' training standards, network solutions, and annual FISSEA speak out.
Technical Contact: Mark Wilson, NIST, Building 820, Room 426, Gaithersburg, MD 20899-0001, phone: 301/975-3870, fax: 301/948-0279, email: mark.wilson@nist.gov.

March 16–18, 1998
STANDARDS FOR NUCLEIC ACID DIAGNOSTIC APPLICATIONS

Location: National Institute of Standards and Technology Gaithersburg, MD

Sponsors: NIST, U.S. Food and Drug Administration-Center for Devices and Radiological Health (FDA-CDRH), National Committee for Clinical Laboratory Standards (NCCLS), Health Care Financing Administration (HCFA), Center for Disease Control and Prevention (CDC), and Association of Government Toxicologists (AGT).
Audience: Scientists from the biotechnology industry, clinical testing laboratories, and government agencies that are involved in creating, using, or regulating nucleic acid tests. Issues of specificity, sensitivity, and ensuring accuracy of these tests will be addressed.
Format: Workshop with panel discussions.
Purpose: To determine the major standardization issues facing the nucleic acid diagnostics community and to arrive at a consensus concerning the management of these issues.
Topics: Diagnostic areas of human identification, genetic testing, infectious disease, and cancer diagnostics.
Technical Contact: Catherine O'Connell, NIST, Building 222, Room A367, Gaithersburg, MD 20899-0001, phone: 301/975-3123, fax: 301/330-3447, email: catherine.oconnell@nist.gov.

March 16–20, 1998 and
October 19–23, 1998
PRECISION THERMOMETRY WORKSHOPS

Location: National Institute of Standards and Technology Gaithersburg, MD

Sponsor: NIST.
Audience: These workshops are intended for calibration laboratory personnel and others who wish to undertake precision temperature measurements. Applicants should possess undergraduate training in physics or engineering and should have some laboratory experience in metrology. Participation is limited to 16 people. There is no on-site registration.
Format: Classroom and laboratory instruction.

Purpose: To provide advice and assistance on measurement and calibration problems, tracing to NIST the accuracies of measurement standards needed for research work, factory production, or field evaluation.
Topics: Temperature scales, platinum resistance thermometry, vapor pressure and gas thermometry, low temperature calibrations, thermistor thermometry, liquid-in-glass thermometry, and thermocouple thermometry.
Technical Contact: Andrea Swiger, NIST, Building 221, Room B128, Gaithersburg, MD 20899-0001, phone: 301/975-4800, fax: 301/548-0206, email: andrea.swiger@nist.gov.

March 23–27, 1998

INTERNATIONAL CONFERENCE ON CHARACTERIZATION AND METROLOGY FOR USLI TECHNOLOGY

Location: National Institute of Standards and Technology Gaithersburg, MD

Sponsors: NIST, SEMATECH, Semiconductor Research Corporation, SEMI, and American Vacuum Society.
Audience: Semiconductor research and development staff in the electronics industry.
Format: Invited oral presentations, contributed poster papers, panels, and equipment exhibition.
Purpose: To bring together scientists and engineers interested in all aspects of the technology and characterization techniques for semiconductor device research, development, manufacturing, and diagnostics: chemical and physical, electrical, optical, in-situ, and real-time control and monitoring.
Topics: The workshop will provide a forum to present and discuss critical issues, problems, evolving requirements and analysis needs, future directions and key measurement principles, capabilities, applications, and limitations.
Technical Contact: David Seiler, NIST, Building 225, Room B344, Gaithersburg, MD 20899-0001, phone: 301/975-2054, fax: 301/948-4081, email: david.seiler@nist.gov. WWW Homepage: http://www.eeel.nist.gov/812/dgs.html.

April 20–22, 1998

5TH ANNUAL NATIONAL MANUFACTURING TECHNOLOGY CONFERENCE

Location: National Institute of Standards and Technology Gaithersburg, MD

Sponsors: NIST, Department of Energy, National Center for Manufacturing Sciences, SCRA, and U.S. Navy.
Audience: Industry, government, and academia.
Format: Technical demonstrations and presentations.
Purpose: To showcase the technical achievements of selected research projects supporting the implementation of next generation manufacturing systems.
Topics: Pervasive modeling and simulations, adaptive responsive information systems, and next-generation manufacturing processes and equipment.
Technical Contact: Melissa Zeltman, NIST, Building 245, Room A327, Gaithersburg, MD 20899-0001, phone: 301/975-3986, fax: 301/926-8730, email: melissa.zeltman@nist.gov. WWW Homepage: http://www.mel.nist.gov/docs/mfgconf/mfgcon.htm.

May 4–5, 1998

METROLOGY FOR ELECTRONIC PACKAGING AND INTERCONNECTION

Location: National Institute of Standards and Technology Gaithersburg, MD

Sponsor: NIST.
Audience: Industry, academia, and government experts in electronic packaging and interconnection.
Format: Technical presentations and working groups.
Purpose: To revise NIST's strategic planning in electronic packaging and interconnection based upon 1997 editors of leading industrial roadmaps.
Topics: Electronic packaging, metrology, interconnection, printed wiring boards, on-chip interconnects, semiconductor packaging, and materials.
Technical Contact: Michael Schen, NIST, Building 224, Room B320, Gaithersburg, MD 20899-0001, phone: 301/975-6741, fax: 301/869-3239, email: michael.schen@nist.gov.

May 11–12, 1998

SECURITY REQUIREMENTS FOR CRYPTOGRAPHIC MODULES WORKSHOP

Location: Gaithersburg Hilton
Gaithersburg, MD

Sponsor: NIST.
Audience: Federal agencies, vendors interested in producing Federal Information Processing Standards (FIPS) 140-1 compliant modules, and companies wishing to implement tested and validated products.
Format: Lectures and panel discussions.
Purpose: To comply with FIPS 140-1, Security Requirements for Cryptographic Modules, and to provide security services such as confidentiality, integrity, and authentication.
Topics: An overview of federal cryptography, a FIPS 140-1 Tutorial, and guidance on implementing FIPS 140-1. How to use the standard, its impact on federal agencies, and how agencies can impact the program.
Technical Contact: Ray Snouffer, NIST, Building 820, Room 426, Gaithersburg, MD 20899-0001, phone: 301/975-4436, fax: 301/948-1233, email: ray.snouffer@nist.gov. WWW Homepage: http://csrc.nist.gov/cryptval.

June 2–5, 1998

EIGHTH INTERNATIONAL SYMPOSIUM ON GASEOUS DIELECTRICS

Location: Virginia Beach Hotel and
Conference Center
Virginia Beach, VA

Sponsor: NIST.
Audience: Academia, researchers, and government.
Format: Technical sessions, contributed papers with discussion and two parallel group discussion sessions.
Purpose: To provide a forum for review and discussion of the progress and problems of current interest in gaseous dielectrics and their use, especially as insulators in high-voltage equipment and substations.
Topics: Basic physics of gaseous dielectrics, basic mechanisms, modeling/simulations, partial discharges/diagnostics, high pressure gas dielectrics, gas decomposition/gas handling, environmental aspects of gaseous dielectrics/recycling, surface discharges/design engineering, and DC GIS/gas-insulated transformers.
Technical Contact: Loucas G. Christophorou, NIST, Building 220, Room B348, Gaithersburg, MD 20899-0001, phone: 301/975-2432, fax: 301/948-5796, email: loucas.christophorou@nist.gov.

June 15–16, 1998

INTERNATIONAL CONFERENCE ON THE ECONOMIC EVALUATION OF TECHNOLOGICAL CHANGE

Location: Georgetown University Conference Center
Washington, DC

Sponsors: NIST/Advanced Technology Program and National Bureau of Economic Research.
Audience: Economists and others who work in evaluation of technological change.
Format: Presentations, panel discussions, and breakout sessions.
Purpose: To discuss state-of-the-art techniques/methodologies used in the evaluation of government-sponsored advanced technologies.
Topics: Spillover pathways, research collaborations, economic modeling and methodology, project and program impact assessment.
Technical Contact: Richard Spivack, NIST, Building 101, Room A303, Gaithersburg, MD 20899-0001, phone: 301/975-5063, email: richard.spivack@nist.gov.

July 6–10, 1998

CONFERENCE ON PRECISION ELECTROMAGNETIC MEASUREMENTS

Location: Washington Renaissance Hotel
Washnington, DC

Sponsors: NIST, Bureau International des Poids et Mesures, IEEE Instrumentation and Measurement Society, National Research Council of Canada, and Union Radio Scientifique Internationale.
Audience: Electromagnetic metrologists, physicists in the fundamental constants area, and instrumentation developers.
Format: Verbal paper sessions, poster paper sessions, and ad hoc working group meetings.
Purpose: To provide a forum in which the international metrology community can discuss the most recent developments in physics and electrotechnology that apply to precision electromagnetic measurements and international standardization.
Topics: Antennas and dielectrics, automated measurement systems, DC/LF measurements and standards, fundamental constants, international compatibility of measurements, microwave/mmwave measurements (RF and EMC), nanotechnology (cryoelectronics), optical wavelength metrology, power and energy, quantum standards, realizations of units, and time and frequency.

Technical Contact: Norman Belecki, NIST, Building 220, Room B164, Gaithersburg, MD 20899-0001, phone: 301/975-4223, fax: 301/926-3972, email: norman.belecki@nist.gov. WWW Homepage: http://www.eeel.nist.gov/cpem98.

July 7–14, 1998

COUPLED OCEAN-ATMOSPHERE RESPONSE EXPERIMENT CONFERENCE COARE '98

Location: National Institute of Standards and Technology Gaithersburg, MD

Sponsors: Climate Variability and Predictability Program (CLIVAR) and Global Energy and Water Cycle Experiment (GEWEX).
Audience: The U.S. atmospheric sciences community.
Format: Breakout sessions, poster sessions, and workstations.
Purpose: To bring together oceanographers and meterologists to review progress with the coupled problems which stimulated COARE, and to bring together and foster collaboration between observers and modelers in pursuit of the general objectives of COARE.
Topics: Heat, moisture and momentum budgets in atmosphere; ocean and the coupled system; scale interactions in ocean, atmosphere and in comparison between COARE IOP results and climatologies.
Technical Contact: Brian Jackson, University Corporation for Atmospheric Research (UCAR), P.O. Box 3000 FL4, Boulder, CO 80307-3000, phone: 303/497-8663, email: bjackson@ucar.edu. WWW Homepage: http://www.joss.ucar.edu/joss_psg/project/coare98.

August 20–21, 1998

INTERNATIONAL WORKSHOP ON OPTICAL FERROELECTRIC MATERIALS

Location: Breckenridge, CO

Sponsor: NIST.
Audience: Optical ferroelectric materials community.
Format: Lecture.
Purpose: This bi-annual workshop is aimed at the science and technology of optical ferroelectric materials, emphasizing areas such as optical telecommunications and remote sensing.
Topics: Optical ferroelectric materials and advances.
Technical Contact: Norman Sanford, NIST, Mailcode 815.04, 325 Broadway, Boulder, CO 80303-3328, phone: 303/497-5239, fax: 303/497-7671, email: sanford@boulder.nist.gov.

September 14–17, 1998

ISIC/CIRA/ISAS '98 IEEE INTERNATIONAL SYMPOSIUM ON INTELLIGENT CONTROL (ISIC) INTERNATIONAL SYMPOSIUM ON COMPUTATIONAL INTELLIGENCE IN ROBOTICS AND AUTOMATION (CIRA) INTELLIGENT SYSTEMS AND SEMOTICS (ISAS)

Location: National Institute of Standards and Technology Gaithersburg, MD

Sponsors: NIST, National Science Foundation, Institute of Electrical and Electronics Engineers Control Systems Society, and U.S. Army Research Office.
Audience: Leading researchers in the area of intelligent systems including design and application.
Format: The conference will be organized in three parallel tracks including nine workshops and three general discussions. The three days of the meeting will be preceded by a day of relevant tutorials.
Purpose: To focus upon learning processes in intelligent systems, and dedicated applied semiotics and its application in large and complex systems, including intelligent machines.
Topics: Large systems, formal tools of semiotics, brain architectures, decision making, planning and control, learning in the systems and applications.
Technical Contact: Richard Quintero, NIST, Building 220, Room B124, Gaithersburg, MD 20899-0001, phone: 301/975-3445, fax: 301/990-9688, email: richard.quintero@nist.gov. WWW Homepage: http://isd.cme.nist.gov/proj/is98/.

November 2–6, 1998

1998 ANNUAL CONFERENCE ON FIRE RESEARCH

Location: National Institute of Standards and Technology Gaithersburg, MD

Sponsor: NIST/Building and Fire Research Laboratory/Fire Science Division.

Audience: Industry, government, and university fire researchers.

Format: Parallel sessions. Purpose: The Annual Conference on Fire Research has long been the prime forum for the presentation and discussion of the latest advances in the science of fire and the engineering of fire safety.

Topics: Fire suppression, fire detection, fire plumes, flame spread, halons, numeric databases, polymers, pool fires, risk assessment, soot, toxicity, urban fires and composites.

Technical Contact: Richard Gann, NIST, Building 224, Room B250, Gaithersburg, MD 20899-0001, phone: 301/975-6864, fax: 301/975-4052, email: richard.gann@nist.gov.

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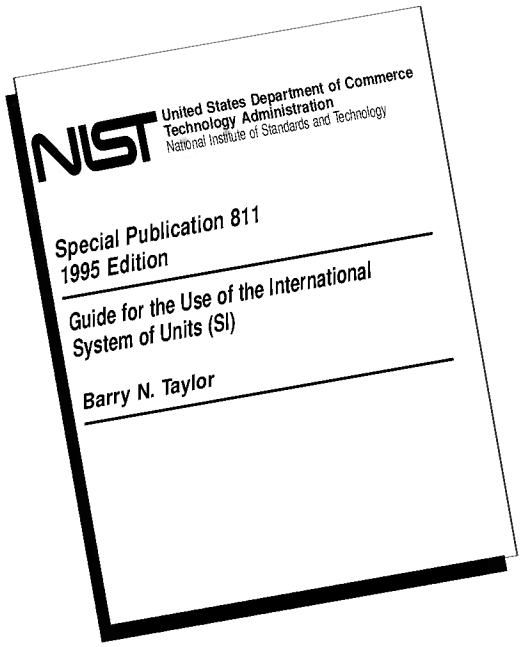
The International System of Units (SI)
The Modern Metric System



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

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

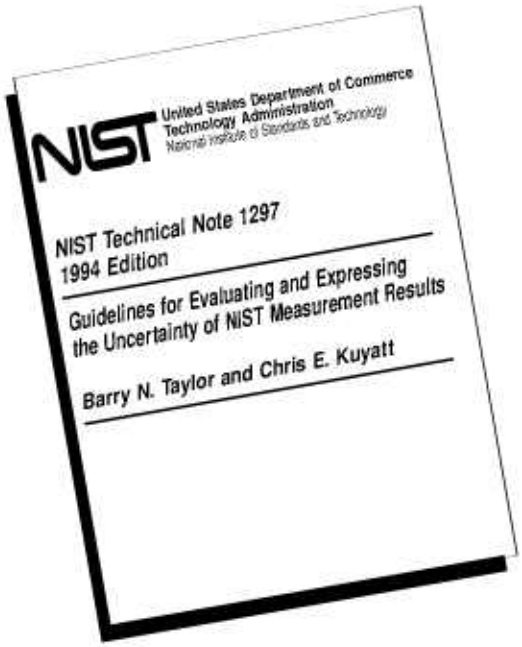
The 1995 edition of SP 811 corrects a number of misprints in the 1991 edition, incorporates a significant amount of additional material intended to answer frequently asked questions concerning the SI and SI usage, and updates the bibliography. The added material includes a check list for reviewing the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

The topics covered by SP 811 include:

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

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

Evaluating and Expressing the Uncertainty of Measurement Results



Uncertain about expressing measurement uncertainty? Do you need to know how NIST states the uncertainty of its measurement results and how you can implement their internationally accepted method in your own laboratory? Then you need the newly available 1994 edition of the National Institute of Standards and Technology Technical Note 1297, *Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results.*

The 1994 edition of the National Institute of Standards and Technology Technical Note 1297, *Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results*, by Barry N. Taylor and Chris E. Kuyatt is now available.

The 1994 edition of TN 1297 includes a new appendix—Appendix D—which clarifies and gives additional guidance on a number of topics related to measurement uncertainty, including the use of certain terms such as accuracy and precision. Very minor word changes have also been made in a few portions of the text of the 1993 edition in order to recognize the official publication in October 1993 by the International Organization for Standardization (ISO) of the *Guide to the Expression of Uncertainty in Measurement* on which TN 1297 is based. However, the NIST policy on measurement uncertainty, Statements of Uncertainty Associated with Measurement Results, which is reproduced as Appendix C of TN 1297, is unchanged.

It is expected that the 1994 edition of TN 1297 will be even more useful than its immediate predecessor, the 1993 edition, of which 10 000 copies were distributed worldwide.

Those United States readers who wish to delve into the subject of measurement uncertainty in greater depth may purchase a copy of the 100-page ISO *Guide* from the Sales Department of the American National Standards Institute (ANSI), 105-111 South State Street, Hackensack, NJ 07601. Copies may also be purchased from the ISO Central Secretariat, 1 rue de Varembé, Case postale 56, CH-1211 Genève 20, Switzerland.

Single copies of the 20-page TN 1297 may be obtained from the NIST Calibration Program, Building 820, Room 232, Gaithersburg, MD 20899-0001, telephone: 301-975-2002, fax: 301-948-3825.

NIST Technical Publications

Periodical

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

Nonperiodicals

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

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

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

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

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

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

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

Order the **following** *NIST publications—FIPS and NISTIRs—from the National Technical Information Service, Springfield, VA 22161.*

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

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

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