

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 101, Room E215, Gaithersburg, MD 20899-2500; telephone: (301) 975-3577.

PREDICTING NONLINEAR EFFECTS IN SUPERCONDUCTING TRANSMISSIONS

Microwave circuits fabricated from high-temperature superconductor (HTS) materials often suffer from detrimental nonlinear effects, such as intermodulation distortion and harmonic generation. The practical result is the creation of unpredictable interference signals with the frequency band of interest for many microwave applications. These nonlinear effects can seriously compromise the utility of microwave devices fabricated from HTS materials. An experimental technique is urgently needed to predict the nonlinear response of HTS microwave devices based on the HTS materials, prior to device fabrication.

In response to this need, researchers at NIST and the Naval Research Laboratory have developed a new screening technique for predicting the nonlinear response of microwave devices fabricated from HTS materials. The technique uses low-frequency (10 kHz) mutual inductance measurements of unpatterned superconducting films to determine the current dependence of the penetration depth. These mutual inductance measurements predict third-harmonic generation in coplanar waveguide devices of different geometries patterned from yttrium-barium-copper-oxide (known as YBCO) thin films. This technique provides a valuable method for determining the nonlinear response of HTS microwave devices prior to circuit fabrication.

Copies of paper No. 51-99, “Predicting Non-linear Effects in Superconducting Microwave Transmission Lines from Mutual Inductance Measurements,” are available from Sarabeth Harris, MC104, NIST, Boulder, CO 80303-3337; (303) 497-3237.

Media Contact: Fred McGehan, (303) 497-3246; mcgehan@boulder.nist.gov.

BALDRIGE PROGRAM FOR EDUCATION GETTING BROAD SUPPORT

Although the Baldrige National Quality Program for education is still very new, many organizations are supporting the program and urging widespread adoption of the Baldrige performance excellence principles. For example, the National Education Goals Panel (NEGP) recently held a nationwide teleconference, “Creating a Framework for High Achieving Schools,” to focus on the Baldrige criteria in education.

In the foreword to a report issued in conjunction with the teleconference, Gov. Tommy G. Thompson of Wisconsin and 2000 chair for the NEGP, said the Baldrige criteria for education “can provide educators with a framework and strategies for improving their schools and helping all children to reach high standards.” At the teleconference, Bob Chase, president of the National Education Association (NEA), said, “The Baldrige process and what I call “new unionism” are a quality match. Most crucially, NEA’s new unionism and the Baldrige process share the same bottom line, improving student achievement.” Further information is available by calling (202) 724-0015 or online at www.negp.gov.

Also, the National Alliance of Business and the American Productivity & Quality Center have formed the Baldrige in Education Initiative, a partnership of 26 business and education organizations dedicated to reforming the education system based on quality principles. Further information is available by calling (800) 787-2848 or online at www.nab.com.

For further information about the Baldrige National Quality Program, call (301) 975-2036 or see the web site at www.quality.nist.gov.

Media Contact: Jan Kosko, (301) 975-2767; janice.kosko@nist.gov.

NEW VIDEO HIGHLIGHTS ATP ROLE IN TECHNOLOGY INNOVATION

For 10 years, the NIST Advanced Technology Program (ATP) has worked to spur the development of path-breaking new technologies by providing cost-shared funding for potentially valuable but high-risk R&D projects. Nearly 200 projects have been completed, and more than 200 currently are under way. In industry after industry—medical diagnostics, semiconductor manufacturing, automobiles, telecommunications, information technology, electronics, high-performance composites, biotechnology the United States can offer the world's markets many leading-edge technologies that we wouldn't have without the ATP.

A new NIST video on the ATP features interviews with industry research managers that highlight how the program enables breakthrough technologies in a wide variety of fields, promotes the formation of cooperative R&D consortia, and offers valuable early support to small entrepreneurial technology firms.

"Innovation and Impact: The Advanced Technology Program," a 12 1/2 minute video, is available in VHS format from the Advanced Technology Program by calling (800) ATP-FUND (287-3863), faxing a request to (301) 926-9524 or sending an e-mail message to atp@nist.gov.

Additional information on the Advanced Technology Program and the new technologies it has helped develop is available online at www.atp.nist.gov.

Media Contact: Michael Baum, (301) 975-2763; michael.baum@nist.gov.

INDUSTRY GIVES "SEAL" OF APPROVAL TO REMOTE WELD MONITORING

Take the power of the Internet, add to it a sophisticated blend of computer brains and robotic dexterity, and then apply the mix to a common, yet vital, manufacturing process. What do you get?

Remotely monitored welding, that's what.

NIST and several industry partners have teamed for years to develop, refine, test and, eventually, commercialize advanced welding technologies such as remote monitoring as part of the NIST-managed National Advanced Manufacturing Testbed (NAMT). The remote monitoring project recently achieved a significant

milestone when one of its partners incorporated NAMT-derived technology into a commercially viable product.

Remote collaboration tools that allow welding experts to debug and optimize automated welding processes from remote locations by videoconferencing—can be integrated into commercial welding systems. This "long-distance repair service" can save manufacturers production time, decrease maintenance, reduce or eliminate travel costs for repairs, and increase the efficiency of automated welding operations.

For more information, contact Bill Rippey, NIST, 100 Bureau Dr., Stop 8230, Gaithersburg, MD 20899-8230; (301) 975-3417; william.rippy@nist.gov.

Media Contact: Michael E. Newman, (301) 975-3025; michael.newman@nist.gov.

EU APPROACH TO STANDARDS EXPLAINED IN NEW NIST GUIDE

A new NIST guide to European Union directives, standards and procedures for demonstrating compliance with these requirements can help aspiring U.S. exporters enter the world's largest regional market.

A Guide to EU Standardization and Conformity Assessment (NIST Special Publication 951) explains the general principles behind the EU's so-called New Approach Directives. These establish uniform health, safety and environmental requirements for major categories of products sold in the EU's 15 member nations. The directives, now numbering 24, supersede the requirements of the individual countries, greatly reducing transnational differences that impeded international trade.

Written by NIST international standards experts, the guide describes the EU approach to setting standards. It also provides an overview of the EU's approach to granting product approvals, and it discusses the steps involved in securing the "CE" mark. Sometimes called the passport to Europe for exports, the CE mark indicates that a product is in compliance with the essential requirements of all applicable directives.

The publication distills relevant technical concepts and terms from the "notified bodies" and "competent bodies" that perform testing or other conformity assessment activities to risk assessment requirements. In addition, aspects of the EU approach to product liability are outlined.

The guide soon will be available from the NIST online library of publications on standards and conformity assessment activities. The web address for downloading will be <http://ts.nist.gov/europe>.

Media Contact: Mark Bello, (301) 975-3776; mark.bello@nist.gov.

CHARPY MACHINE OPERATION AND MAINTENANCE IS EASIER BY THE BOOK

A new publication from NIST will be of interest to the more than 1000 owners worldwide of Charpy impact testing machines. These machines, based on the swing of a pendulum, are used to determine the temperature at which structural materials go through a ductile-to-brittle transition. Charpy impact testing is often specified as an acceptance test for materials used in critical structures such as bridges and pressure vessels.

The latest NIST document describes recommended practices for installing, maintaining, and verifying Charpy impact machines. In great detail, NIST explains how to prepare the foundation for the machine to rest on, the type of bolts to use to secure it to the foundation, and the type of grout to use to interface between the machine and the foundation. The publication also describes direct and indirect means of verifying that the machine is in good operating condition and is functioning as closely as possible to a simple pendulum with only small losses due to friction and windage. The indirect verification method, which uses carefully characterized test specimens to stress the machine components to levels similar to those experienced during routine usage, serves as an important supplemental test of the machine performance. The publication comes in two sizes, 8 1/2 × 11 in or 5 1/2 × 8 1/2 in; the latter is a handy size to keep near the test machine.

For a free copy of NIST Technical Note 1500-8, Recommended Practice: Installing, Maintaining and Verifying Your Charpy Impact Machine, contact Sarabeth Harris, MC 103, NIST, Boulder, CO 80303-3337; (303) 497-3237; sarabeth@boulder.nist.gov. Please specify the size you wish to order. Media Contact: Fred McGehan, (303) 497-3246; mcgehan@boulder.nist.gov.

NIST'S CRYPTOGRAPHIC MODULE VALIDATION PROGRAM VALIDATES THE FIRST LEVEL 2 SMART CARD

The Cryptographic Module Validation Program (CMVP) of the U.S. and Canadian governments achieved another major milestone by validating the first level 2 smart card cryptographic module on May 8, 2000. This event was followed by a second validation of a level 2 smart card the same day. The SignaSURE Model 330 Smart Card by one private company was validated as the CMVP's 94th cryptographic module and the Rosetta Smart Card by another company became the CMVP's 95th. The SignaSURE smart card is a complete public key cryptographic module that is ISO 7816 compliant and supports the Public Key Infrastructure (PKI) with a highly efficient cryptographic

co-processor and the DKCCOS v2.0 smart card operating system (OS). The SPYRUS Rosetta Smart Card is also an ISO 7816 compliant public key smart card and is based upon the SPYCOS card operating system. These validations continue the CMVP's near exponential growth in the number of validated modules per year and also increase the total number of validated modules by nine since January 2000. Certificate number 100 is expected soon. Cryptographic modules are validated against Federal Information Processing Standard (FIPS) 140-1, Security Requirements for Cryptographic Modules, which specifies four increasing levels of security assurance.

The FIPS 140-1 Validated Modules List has become a "Who's Who" of cryptographic and information technology vendors and developers from the United States, Canada, and abroad. The list contains a complete range of security levels and a broad spectrum of product types including secure radios, Internet browsers, VPN (virtual private network) devices, PC Postage equipment, cryptographic accelerators, secure tokens, smart cards, and others. The recent validations impact federal agencies by further increasing the both number and types of tested and validated cryptographic products available for use in securing sensitive information.

The CMVP is a joint effort between NIST and the Communication Security Establishment (CSE). NIST and CSE serve as the validation authorities for the program.

For more information on FIPS 140-1, validated modules, and the accredited laboratories, see <http://csrc.nist.gov/cryptval>.

CONTACT: Ray Snouffer, (301) 975-4436; stanley.snouffer@nist.gov.

BIPV WEATHER STATION

Researchers at NIST have developed a real-time database of weather information that can be accessed over the web as part of the Building Integrated Photovoltaics (BIPV) project. The database enables collaborators throughout the world involved in solar energy research to access information obtained in experiments at NIST. These data can be used in model development and verification as well as product design and the development of installation procedures for solar panels. In addition to common weather data such as temperature, wind speed, and wind direction, instruments collect data on direct solar radiation, global solar radiation, and diffuse solar radiation. The data are archived every 5 minutes and can be accessed from any web browser. The web page provides the latest weather conditions and allows users to examine past data over any specified time range.

Averages of the data and integrated solar power are computed and presented along with plots of the data over the specified time. The plots are generated using the NIST Data Viewer applet originally developed for the NIST Chemistry WebBook and modified for this application. Another feature of the web site is a description of each instrument used in the weather station that gives the user further information on the data collection. The availability of such detailed solar measurements over the web significantly aids the solar energy research community. The web page can be found at <http://www.bfrl.nist.gov/863/bipv>.

CONTACT: William Healy, (301) 975-4922; william.healy@nist.gov.

BACnet EXPANDS FUNCTIONALITY FOR INTEGRATING LIFE SAFETY SYSTEMS WITH OTHER BUILDING AUTOMATION AND CONTROL SYSTEMS

For many years the building industry has struggled with the problem of integrating control devices made by different manufacturers in order to optimize operations, improve safety, and reduce maintenance costs. A key step toward overcoming these difficulties was the adoption of BACnet—A Data Communication Protocol for Building Automation and Control Networks—as an American national standard in 1995. BACnet was developed by NIST researchers and industry partners under the auspices of the American Society of Heating and Refrigerating Engineers (ASHRAE).

Early implementations of BACnet have primarily been for heating, ventilation, and air conditioning (HVAC) system applications but more recently, manufacturers of other kinds of building automation and control systems have been adopting BACnet. The fire detection industry has been one of the leaders because of the need to interact with HVAC systems for smoke control. Field experience indicated that there was a need for some additional features in BACnet to best meet this application.

NIST formed a group consisting of fire system experts from the National Electrical Manufacturers Association and the National Fire Protection Association, along with BACnet experts from ASHRAE, to develop an addendum to BACnet that addresses the specific life safety systems needs. This addendum, known as Addendum c to ASHRAE/ANSI Standard 135, has been approved for public review and comment. It is expected to be formally adopted as part of the standard later this year.

CONTACT: Steven Bushby, (301) 975-5873; steven.bushby@nist.gov.

NIST DEVELOPS ULTRA-NARROW-LINE-WIDTH OPTICAL FREQUENCY STANDARD

NIST scientists have produced the highest- Q ($\approx 1.6 \times 10^{14}$), narrowest-linewidth optical frequency standard ever demonstrated. They accomplished this feat by locking the frequency of an ultra-narrow-linewidth laser to an ultraviolet transition in a single $^{199}\text{Hg}^+$ ion. Systems with such exceptional Q are extremely attractive as frequency standards, since large Q translates to small uncertainty in locating the line center of the resonance. The scientists project that the relative uncertainties for such standards should approach 1×10^{-18} , orders of magnitude better than the best present microwave frequency standards. Of course, systematic frequency shifts caused by non-ideal experimental conditions must be considered, but while these limit the performance in the present experiments to an uncertainty of the order 10^{-14} , they appear to be controllable at much lower levels. The optical-frequency output of this standard will be linked to the microwave region using new frequency synthesis methods based on frequency combs produced by mode-locked, femtosecond lasers.

CONTACT: James C. Bergquist, (303) 497-5459; bergquist@boulder.nist.gov.

DEFINITIVE ARTICLE ON THE FUNDAMENTAL PHYSICAL CONSTANTS PUBLISHED IN JPCRD AND RMP

Two NIST scientists have recently published a 140-page definitive article that gives the 1998 CODATA (Committee on Data for Science and Technology) recommended values for fundamental physical constants. The article is entitled “CODATA Recommended Values of the Fundamental Physical Constants: 1998” and was published in two well-known scientific journals: *Journal of Physical and Chemical Reference Data* and *Reviews of Modern Physics*. The paper took over 4 years to complete. It was prepared under the auspices of the CODATA Task Group on Fundamental Constants and reviews all of the data relevant to the constants that were available by the end of 1998, describing in detail both the data and the analysis techniques used to obtain them.

Although it is highly unusual for such a lengthy article to be published in two different journals, the editors of the journals decided to do so because of the importance of the fundamental constants to all of science and technology. Furthermore, the decision by CODATA to issue a new set of values of the constants more frequently than in the past gives added importance to the paper. (The last set of CODATA recommended values was issued in 1986.) A reprint of the article may be obtained from the authors.

CONTACT: Peter J. Mohr, (301) 975-3217; peter.mohr@nist.gov or Barry N. Taylor, (301) 975-4220; barry.taylor@nist.gov.

MODELING OF STRUCTURAL CHANGES IN METALS

Metallic materials in general are composed of tiny crystals, or “grains,” which form during solidification but can change in size, shape, and orientation during subsequent processing of the metal. The grain structure of a metal contributes to important mechanical and physical properties of the material, and understanding how this grain structure develops is a critical part of understanding how the metal should be processed.

Several theories have been developed to describe the development of grain structure in metals, but until now they have had difficulty describing the complex changes in geometry which occur. A new model of the motion of grain boundaries and rotation of grains in metals during casting or other processing has now been developed by NIST scientists. This “phase field” model, based on ideas developed to model solidification, permits evolution of interfaces to be calculated on a computationally simple fixed grid. This computational benefit is obtained by allowing the interface to have a finite width, which contrasts with previous models that attempted to explicitly track the location of a sharp interface. This model of grain boundary dynamics improves upon existing phase field models of the same phenomenon in that it has a simpler mathematical representation and allows for grain rotation. These improvements will result in more accurate simulations of the casting of polycrystalline industrial materials.

CONTACT: James Warren, (301) 975-5708; james.warren@nist.gov.

THE MEASUREMENT OF ELASTIC PROPERTIES OF SPRAYED COATINGS BY NEUTRON DIFFRACTION

Thermal sprayed coatings play an important role as protection against thermal and corrosive exposure, wear and mechanical loads. Due to the defect structure and porosity of thermally sprayed deposits, their elastic constants become anisotropic and they can differ significantly from those of bulk materials with the same chemical composition. The knowledge of the elastic properties can be essential for the analysis of stress/strain behavior critical for performance and lifetime assessments.

Very recently, NIST researchers introduced a new method for measuring these elastic constants by means of diffraction. Experimentally, the method relies on

lattice strain measurements under applied load for various specimen directions and crystallographic reflections (*hkl*). By means of neutron diffraction it was possible to measure the elastic behavior perpendicular and parallel to the surface of thin coatings in an in situ load device, thus making a full set of elastic data for the two principal coating directions available.

Using the recently developed theoretical relationship between these experimental data and the coating elastic constants, the latter quantities can be calculated, thus making important engineering data accessible by means of a new and relatively simple method.

CONTACT: Thomas Gnäupel-Herold, (301) 975-5380; thomas.gnaupel-herold@nist.gov or Henry J. Prask, (301) 975-6226; henry.prask@nist.gov.

NIST COLLABORATION DEMONSTRATES OPTICAL TECHNIQUES FOR THE CHARACTERIZATION OF POLYMER INTERFACES

NIST researchers have collaborated on a project to develop new procedures based on state-of-the-art femtosecond lasers for the application of vibrationally resolved sum frequency generation (VR-SFG) to the study of the interfaces of thin polymer films.

Polymer thin films have important roles in many industries as varied as semiconductor devices, automobile coatings, and construction materials. The structure at both the free and buried interfaces of thin films are critical to their performance as they can determine characteristics such as adhesion and wear. However, very few analytical techniques have the requisite sensitivity and selectivity to study polymer interfaces.

VR-SFG is a promising tool for the study of interfaces as it is specifically forbidden in the bulk region of centrosymmetric films but allowed at interfaces because of their reduced symmetry. However, when multiple interfaces are present as in the study of thin films, techniques must be developed to distinguish the contributions to the VR-SFG signal from each interface present. Standard practice is to destructively modify the free interface and identify the features that are perturbed. The NIST team developed a general technique, utilizing optical interferences in thin films, to avoid this practice. By systematically varying film thickness, spectra can be acquired that selectively probe the buried or the free interface of the film. Additionally, the NIST approach identifies the experimental conditions that enhance signal levels, allowing for more efficient data acquisition. The approach has been demonstrated in a study of the orientational distribution of the phenyl rings at the interfaces of polystyrene films that have been spin cast onto oxidized Si substrates. At the free

interface, the phenyl rings are strongly ordered, with a net orientation directed away from the bulk of the film, into the air. At the buried interface, the level of order is reduced significantly, and the rings have little preference for orientation with respect to the oxidized substrate.

The technique now is being used in studies directly correlating the molecular structure of polymer/polymer interfaces important to electronics applications and reactive polymer blends with their mechanical properties.

CONTACT: Lee Richter, (301) 975-4152; lee.richter@nist.gov.

NIST CHARACTERIZES PULSED INDUCTIVELY COUPLED PLASMAS FOR SEMICONDUCTOR INDUSTRY

In recent years, the use of pulsed radio frequency (rf) inductively coupled plasmas by the semiconductor industry during fabrication of microcircuits has attracted increased attention. Pulsed modulation of inductively coupled plasmas provides additional control over plasma properties. For example, pulsing the discharge decreases the accumulation of surface charge, which otherwise can lead to electrical breakdown across thin dielectric films.

Recently, one of the NIST Gaseous Electronics Conference (GEC) Reference Cells and an accompanying ion flux monitor were modified to operate in a pulsed mode, a development that permitted the first studies of the time evolution of ion energy distributions (IEDs) and light emissions over the pulse cycle for discharges in gas mixtures with, e.g., mole fractions of 50 % Ar and 50 % CF₄. These measurements are of considerable interest because ion bombardment plays a crucial role in the etching process and because two modes of discharge can occur during the pulse cycle, the so-called dim or bright modes. Dramatic changes were observed in the IEDs and light emission as the plasma discharge underwent transitions between the two modes.

The NIST IED measurements have been complemented by the recent development at NIST of a method for calculating IEDs using a simplified kinetic approach. This elementary approach makes the connection between commonly measured plasma parameters and measured ion energies more transparent. Given an experimentally determined IED, the reverse process of determining the average potential profile allows some features of the profile in the sheath and presheath to be inferred. The results of the NIST measurements and calculations were reported in the *Journal of Applied Physics*.

CONTACT: James K. Olthoff, (301) 975-2431; james.olthoff@nist.gov.

TRANSMISSION LINE PROBE DEVELOPED FOR PRINTED WIRING BOARDS

A probe for testing transmission lines on printed wiring boards (PWBs) has been designed and developed at NIST. The new probe exhibits exceptional performance with a 15 GHz (–3 dB attenuation) bandwidth and is capable of over 100 000 contact cycles without showing performance degradation. The probe was delivered to a well-known PWB manufacturer for testing in their plant. Initial results show a decrease in operator-induced measurement uncertainty of about 50 % for the NIST probe, compared to the performance of other commercially available probes. The operating bandwidth, cycle time, cost, and calibration support for the NIST probe also was very favorable. A paper describing this development was presented at the 1999 IPC Printed Circuits Expo Technical Symposium.

As a result of this development, several other PWB manufacturers have contacted NIST regarding the needs for improved transmission line characterization methods and for accurate characteristic impedance standards. Standard test methods and an artifact standard that can be used with commercial equipment are needed. The new NIST probe can help to meet this demand.

Interactions with the IPC (formerly known as the Institute for Interconnecting and Packaging of Electronic Circuits) have indicated a need for improving the entire measurement chain (measurement system, probe station, measurement method, data analysis, and impedance standard). The U.S. printed wiring board industry is very cost conscious and must contend with aggressive competition; savings of fractions of a cent per board are significant.

CONTACT: Barry A. Bell, (301) 975-2419; barry.bell@nist.gov.

TIME DOMAIN CALIBRATIONS ON ULTRA-WIDEBAND EMISSION SOURCES

A NIST scientist, project leader of the Free-Field Time-Domain metrology project, completed an evaluation of a highly stable electromagnetic interference reference ultrawideband (UWB) emissions source. The radiated field measurements were made possible by the earlier NIST development of special UWB antennas with constant gain and linear phase response. A time-domain, three-antenna method was used to obtain the antenna factor using the emissions source, enabling radiated field quantities to be computed. Signal process-

ing techniques were applied to the sampled data to obtain spectral amplitude information as well as free-field transmission characteristics. This work was carried out in preparation for an effort to characterize a family of proposed new commercial UWB wireless communications technologies and their impact on existing spectral usage and regulatory activities.

CONTACT: Bob Johnk, (303) 497-3737; johnk@boulder.nist.gov.

NIST ORGANIZES FIRST MEETING OF MACHINE TOOL STANDARDS COMMITTEE

NIST staff organized the first meeting of the ASME TC56 standards committee on “Information Technology for Machine Tools” held in April 2000, in Charlotte, NC. Twenty-four participants contributed to the first meeting, including representatives from machine tool builders, machine tool users, machine tool metrology equipment suppliers, manufacturing software vendors, and academia.

A NIST staff member was elected chair of the new TC56 committee. The committee established its scope and priorities and formed seven working groups to carry out the work. The committee seeks, within 1 year, to standardize information models and associated data formats for machine tool performance data to enable efficient archiving and exchange of machine information throughout the production lifecycle. In particular, the committee will address machine tool specifications (e.g., machine configuration, workspace, performance characteristics, controller information, and auxiliary devices) and results and properties of machine tool performance tests (e.g., test results, procedures, and equipment).

NIST and the diverse group of companies that initiated this committee expect that resulting standards will facilitate the collection, storage, use, and distribution of machine tool performance data within and among organizations as well as development of third-party analysis software, databases, and internet-based tools. Strong industry support indicates that this effort is very timely and critical to U.S. manufacturers.

The committee was formed as a result of prior NIST research to develop machine tool performance data formats and a data repository structure. Initial work by a NIST-led industrial consortium has made significant progress in each of the areas to be addressed by the new standards committee. NIST contributions to this area are sponsored in part by the NIST National Advanced

Manufacturing Testbed (NAMT) program to address information-based manufacturing issues.

CONTACT: Alkan Donmez, (301) 975-6618; alkan.donmez@nist.gov or Hans Soons, (301) 975-6467; hans.soons@nist.gov.

THE FORUM WORKSHOP ON MEASUREMENT NEEDS FOR FIRE SAFETY

Twenty-five representatives from major fire laboratories around the world gathered at NIST for 3 days in early April to lay the ground work for an international cooperative program designed to improve fire researchers’ ability to experimentally characterize fire behavior. “The Forum Workshop on Measurement Needs for Fire Safety” was attended by representatives from Canada, China, Denmark, Finland, Germany, Japan, Norway, Sweden, the United Kingdom, and six organizations in the United States. The workshop was organized by a NIST scientist under the auspices of the Forum for International Cooperation in Fire Research, an organization consisting of leaders from the world’s leading fire laboratories and dedicated to fostering international cooperation in fire research. Experts summarized the status of fire models that are being developed to address a number of purposes with a particular focus on the experimental results required for verification and validation. Current experimental capabilities also were summarized. These presentations formed the foundation for discussions aimed at identifying the measurement technologies that are most critical to and offer the best opportunities for improving the capabilities of fire models. Measurements of heat flux, heat release rate, temperature, and velocity in and around fires were identified as being critical. The group ultimately focused on heat flux measurements to surfaces as being most important due to the central role this parameter plays in fire spread and flashover. A cooperative research program was recommended with the goals of quantifying uncertainties in heat flux measurements, reducing the uncertainties to the point where there is general agreement as to the value and usefulness of the measurements and providing written guidelines for harmonizing experimental procedures across laboratories. A follow-up meeting is being planned during which technical experts from the participating laboratories will prepare a coordinated research plan designed to meet these goals.

CONTACT: William Grosshandler, (301) 975-2310; william.grosshandler@nist.gov.

NIST SPONSORS WORKSHOP ON MULTIZONE AIRFLOW AND INDOOR AIR QUALITY (IAQ) MODELING

In April 2000, NIST held a workshop on the application of multizone airflow and contaminant dispersal modeling to building ventilation and IAQ issues. This workshop was held as part of a larger effort to develop a web-based environment to foster the development and facilitate the application of multizone ventilation and indoor air quality modeling in the areas of building design operation, maintenance, forensics and research. Participants included designers and operators of HVAC systems, fire and smoke control systems, and nuclear facilities.

Multizone building airflow and air quality analysis has been used for a number of years, primarily for detailed building simulation studies to support research efforts. Multizone simulation also has had more limited application within the building design community to develop stairwell pressurization and natural ventilation systems. As building professionals now must respond to more demanding ventilation, energy efficiency, and indoor air quality requirements and to more sophisticated customer needs, current design approaches for addressing airflow and ventilation in buildings are becoming increasingly inadequate. Existing and future multizone airflow analysis approaches offer the possibility of addressing these design and operation problems more directly and effectively. In addition, web-based approaches can make existing simulation and emerging design analysis tools available to a broader audience.

The goal of the workshop was to obtain industry perspectives on multizone modeling and to explore opportunities to further its use. Participants learned how to use a multizone-modeling tool, CONTAMW, developed by NIST, and heard presentations by current users on how they apply multizone modeling to solve real-world problems.

CONTACT: Stuart Dols, (301) 975-5860; stuart.dols@nist.gov.

GETTING IT RIGHT THE FIRST TIME

NIST co-hosted, with the Integrated Manufacturing Technology Initiative, an industry workshop on the topic of “First Part Correct” in April 2000. First Part Correct is the ability to design and manufacture a product correctly, the first time and every time. As companies get “leaner” and as the consciousness of the necessity of productivity improvement is raised, First Part Correct is emerging as a critical success discriminator. A select group of manufacturing experts

representing various industry segments, industry associations, and government programs came together to explore what First Part Correct encompasses, share today’s best practices, and define a vision and steps to achieve that vision. The main technical issues being addressed are development of an advanced controller testbed, study of “automagic” product development (the automatic translation of customer requirements into a finished product), and development of an emerging technology database. A roadmap synthesizing the workshop’s results will be issued this summer, with follow-on workshops being planned.

CONTACT: Elena Messina, (301) 975-3510; elena.messina@nist.gov.

NIST SPONSORS THIRD ADVANCED ENCRYPTION STANDARD (AES3) CONFERENCE

In April 2000, NIST hosted the Third Advanced Encryption Standard Candidate Conference (AES3) in New York City. AES3 gave cryptographers, software and hardware implementers, and other people in the global cryptographic community the opportunity to present and discuss the recent analysis of five encryption algorithms being considered for the Advanced Encryption Standard (AES). More than 250 people from over 30 countries attended the last of three NIST-sponsored conferences related to the AES development effort.

In August 1999, NIST announced that five algorithms—MARS, RC6™, Rijndael, Serpent, and Twofish—would undergo a second round of analysis and evaluation by the public, NIST, and other organizations. From Aug. 9, 1999, through May 15, 2000, in response to a call for Round 2 comments on the finalists, NIST received more than 40 papers and 90 pages of e-mail comments. For AES3—held one month prior to the end of the Round 2 comment period—37 papers analyzing the finalists were considered by the AES3 Program Committee (consisting of NIST personnel and representatives from academia and industry).

A total of 23 papers were presented at AES3. They ranged from the cryptanalysis of reduced-round versions of several algorithms, to the analysis and discussion of AES issues regarding the number of algorithms to select for the standard and their implementation requirements. Additionally, a handful of papers discussed the suitability and performance of the finalists in hardware, for both Application-Specific Integrated Circuits (ASICs) and Field Programmable Gate Arrays (FPGAs). Such analysis had not been available during Round 1 of the AES development effort (August 1998-June 1999). Near the end of AES3, the submitters of the finalists

presented their cases as to why their algorithms should be selected for the AES standard. Conference attendees then were given the opportunity to ask questions of the submitters, pose questions to NIST, and express their views on various issues.

The discussion and presentations at AES3 proved to be very valuable for NIST personnel who are currently making the selection for the AES. All Round 1 and Round 2 comments, papers from the three AES conferences, and other information are being considered in the selection process. An announcement of NIST's selection is anticipated in summer 2000, when NIST will also release a "Round 2 Report" that offers a rationale for its selection. Shortly thereafter, NIST will release a Draft AES Federal Information Processing Standard (FIPS) for public comment. Barring any unforeseen delays, an AES FIPS should be published and available by mid-year 2001.

Information on AES3, including links to papers and presentations from the conference, is available at <http://csrc.nist.gov/encryption/aes/round2/conf3/aes3conf.htm>.

For more information on NIST's AES development effort, see the AES home page at <http://www.nist.gov/aes/>.

CONTACT: Jim Foti, (301) 975-5237; james.foti@nist.gov

NIST HOSTS CONFERENCE ON SECURITY TECHNOLOGIES AND NETWORKING

In April 2000, NIST hosted a workshop for researchers developing Public Key Infrastructures (PKIs) for Advanced Network Technologies. Co-sponsors included the Critical Infrastructure Assurance Office and the Office of Science and Technology Policy's interagency research coordinating groups on large scale networking, critical infrastructure protection, and high confidence systems. The workshop provided a basis and context for developing a roadmap for implementing high-confidence PKI collaborative experiments and testbeds that addressed issues related to scalability, interoperability, and testing. Sessions explored optimized PKIs for advanced network technologies, managing PKI technology transfer, high-confidence tools for testing and assurance, legal and policy frameworks, and PKI-enabled applications. The workshop promoted the use of a high-confidence PKI and related security technologies that provide for the security services needed for advanced distributed applications in e-commerce and related critical systems in banking and finance, energy,

transportation and the telecommunication sectors. WebCast by NIST, the workshop is archived at <http://real.nist.gov>.

CONTACT: Robert Rosenthal, (301) 975-3603; robert.rosenthal@nist.gov.

NIST AND JAPANESE AGENCY OF INDUSTRIAL SCIENCE AND TECHNOLOGY (AIST) HOLD SIXTH INFORMATION EXCHANGE

NIST and the Japanese AIST, Ministry of International Trade and Industry, conducted their Sixth Joint Information Forum on standards and conformity assessment issues in April 2000. The aim of these forums is to build a strong and lasting relationship for activities of mutual interest in the Asia-Pacific region and internationally.

Forum participants exchanged information on mutual recognition of measurement standards, the status of the Asia Pacific Economic Cooperation Telecommunications Mutual Recognition Arrangement (MRA), and the U.S.-EU MRA. Similar arrangements that Japan has with its major trading partners also were reviewed. Other discussions included recent developments in the International Organization for Standardization (ISO) Committee on Conformity Assessment, the National Cooperation for Laboratory Accreditation, and the International Laboratory Accreditation Cooperation. In addition, cooperation in the ISO and International Electrotechnical Commission was discussed, and the standards development processes in the United States and Japan were described.

NIST staff provided information on international activities in the area of color management for digital cameras and color scanners, and reported on activities in the areas of pressure vessels, iron and steel, and welding. AIST representatives described current Japanese efforts and support in these areas.

In a visit to the office of the United States Trade Representative, the Japanese delegation was given an overview on U.S. policy and activities related to the World Trade Organizations Committee on Technical Barriers to Trade, the Organization for Economic Cooperation and Development, the Asia-Europe Meetings, and the Transatlantic Business Dialogue.

In closing remarks, the heads of the two delegations expressed their beliefs that the 2 day session had been extremely productive, with bright prospects for continuing cooperation and the NIST-AIST dialogue.

CONTACT: Christine DeVaux, (301) 975-5503; christine.devaux@nist.gov.

NIST PUBLISHES NISTIR 6515: SEMI-ANNUAL LISTING OF THE NORTH AMERICAN QUALITY SYSTEM REGISTRATION ORGANIZATIONS (NAQSRO)

NIST has published an annotated compilation of International Organization for Standardization (ISO) 9000, QS-9000, ISO 14000 (EMS), and/or equivalently qualified registrars who are listed in the United States, Canada, and Mexico. NISTIR 6515 is produced through the Technical Standards Activities Program and is intended to aid private industry, government, academia, and other sectors with obtaining information on the accreditation and certification of quality system registrars in North America.

The information in this publication is based entirely on data from the registrars returned in response to request for the most recent update (April 2000). It is provided as a service to the public, but there has been no attempt to evaluate the listed programs. Interested parties are advised to review and compare the offered services and the registrars' qualifications as indicated and then select the program(s) deemed most appropriate to their needs. To assist the reader, a Table of Contents, Selected Glossary, and two Appendices have been included in the volume. For those seeking an on-line version, this publication will be accessible at the NIST web page located under "Whats New" at ts.nist.gov/tsap. CONTACT: Michael E. Squires, (301) 975-4039; michael.squires@nist.gov.

NIST LEADS INTERNATIONAL COMPARISON OF POWER AND ENERGY MEASUREMENTS

Large-scale, formal comparisons, within and between the world's metrology regions, are critical elements in facilitating international trade through mutual recognition agreements. The largest formal international comparison ever of 50 Hz/60 Hz power recently was completed in which NIST served as the pilot laboratory. The duties of NIST included selection and periodic calibration of the traveling standard, coordination of transportation, scheduling of testing, and final analysis of the data. In all, 15 national metrology institutes (NMIs) from six metrology regions participated in the comparison, which began in June 1996. The participating NMIs were from Argentina, Australia, Brazil, Canada, China, Germany, Italy, Mexico, New Zealand, Russia, Singapore, South Africa, Sweden, United Kingdom, and the United States.

While state-of-the-art relative uncertainty for power is about 5×10^{-6} , the current results indicate that most of the measured values fall within 25×10^{-6} of each other. While this level of agreement is more than an order of

magnitude better than the uncertainty required for revenue metering, there is increasing demand for lower revenue supporting measurements. This indicates the continued need for interactions between NMIs in this key measurement area.

CONTACT: James K. Olthoff, (301) 975-2431; james.olthoff@nist.gov.

NIST TO PURCHASE WIND-GENERATED ELECTRICITY

In an agreement with the Public Service Company of Colorado (PSCo), The NIST Boulder laboratories has declared its intent to purchase 73 500 kWh per month of its electric energy from wind-generated sources over the next several years. This action is in response to the President's Executive Order 13123, which directs federal agencies to increase their use of renewable energy. Most of the wind energy will come from PSCo's Windsource program. Windsource's wind farm in northern Colorado currently has 29 turbines with a total generating capacity of 20 MW. The turbines, each composed of a tubular tower, a turbine body, and a three-blade rotor, require winds as light as 11 km/h to operate—assuring nearly constant operation. The turbines' tubular design makes it impossible for birds to perch or nest on the wind generators. The turbines weigh 89 metric tons each and stand 55 m above the ground. The rotor blades, which turn to face the prevailing wind, are 48.5 m in diameter and surprisingly quiet in operation. NIST is one of about 30 federal agencies who are participating in the program.

CONTACT: Rosemary C. O'Connor, (301) 975-5238; roconnor@boulder.nist.gov.

THIRTEEN IS LUCKY NUMBER FOR INTERNATIONAL COOPERATION, COMMERCE

Thirteen nations have joined an international computer security agreement that makes it easier for American companies to sell their products in other countries.

In a ceremony on May 23, 2000, Australia, Canada, Finland, France, Germany, Greece, Italy, the Netherlands, New Zealand, Norway, Spain, the United Kingdom and the United States signed the Common Criteria Recognition Arrangement. The signing took place at the First International Common Criteria Conference in Baltimore. About 600 people from 25 countries attended the historic conference, including representatives of leading information technology software manufacturers.

The Common Criteria establishes a common language for specifying security requirements in IT products and systems and a rigorous testing approach to evaluate the security features in those products and systems. Signatory nations recognize the results of security evaluations conducted by each other's accredited testing laboratories. This eliminates the need for costly and time-consuming testing in each country where a company wants to sell its products. As the agreement creates a standardized evaluation process across borders, it fosters a barrier-free, worldwide market for IT security products.

The Common Criteria became an international standard, ISO/IEC Standard 15408, last year. While private laboratories do the testing of computer security products, the governments involved accredit the participating laboratories and certify or validate the resulting tests. NIST and the National Security Agency jointly manage the evaluation and validation program in the United States.

More information about the Common Criteria may be found on the World Wide Web at <http://niap.nist.gov/cc-scheme/index.html>.

Media Contact: Philip Bulman, (301) 975-5661; philip.bulman@nist.gov.

PARTNERS ENSURE THAT E-BUSINESS IS TIMELY BUSINESS

A private company, which is an international provider of audited time-setting services, has signed a cooperative research and development agreement with NIST that will have NIST configure, monitor, and certify time servers (computers that provide time signals via the Internet) housed at the company's timing centers worldwide.

The agreement is the first collaborative research project to examine secure methods of time-data distribution which offer the highest level of time-setting accuracy across open networks such as the Internet and across closed networks with Internet access.

The company's service synchronizes a customer's transaction server clock or desktop computer clock to NIST-traceable time through one of their several regional centers. The company's secure time-setting and time-data auditing services are designed to meet the most stringent requirements of e-business audit models.

For more information, contact CertifiedTime at (408) 371-5300 or go to the World Wide Web at www.certifiedtime.com.

Media Contact: Collier Smith, (303) 497-3198; smithcn@boulder.nist.gov.

PARTNERSHIP PROPOSED TO REDUCE DUPLICATION

NIST and the National Cooperation for Laboratory Accreditation (NACLA) are proposing a partnership to achieve a broadly recognized laboratory accreditation system, thereby simplifying the processes for demonstrating that products comply with United States and foreign requirements.

Laboratory accreditation is a form of conformity assessment—the set of activities intended to assure that products, processes or systems comply with regulations or voluntary standards. It includes procedures for evaluating the competency of accreditors that assess the proficiency of testing laboratories. The aim of the proposed NIST-NACLA memorandum of understanding (MOU) is “to reduce redundancy and complexity” in methods for recognizing laboratory accreditors.

In the United States, there are an estimated 50 000 testing laboratories and more than 100 laboratory accreditation programs, nearly all of them in the private sector. Although it has effectively addressed safety and consumer-protection needs, this decentralized system is sometimes criticized as inefficient. Many testing laboratories, for example, undergo multiple accreditation audits to satisfy various government and industrial programs, even though their requirements and scopes of accreditation are similar.

NACLA is a non-profit corporation founded in 1998 to recognize U.S. accrediting bodies. It is anticipated that accrediting bodies that have been recognized by NACLA under the provisions of the MOU will be deemed competent by NIST to support trade agreement activities where NIST is a designating authority.

Details of the proposed MOU were discussed at a public workshop in June 2000, at NIST's Gaithersburg, MD, headquarters. Go to the World Wide Web at www.ts.nist.gov for information and a copy of the draft MOU. Written comments about the MOU should be sent to “NACLA Comments,” Office of the Director, Technology Services, NIST, 100 Bureau Dr., Stop 2000, Gaithersburg, MD 20899-0001.

Media Contact: Mark Bello, (301) 975-3776; mark.bello@nist.gov.

NEW MEMS FACILITY OPENS IN BOULDER

NIST has opened a world-class Micro Electro Mechanical Systems facility at its Boulder, CO, laboratory. Microelectromechanical systems (MEMS), research is performed in a microfabrication cleanroom where mechanical and electronic components are integrated. Similar facilities are used by industry to build microchip

accelerometers for controlling air bags, gyroscopes for aerospace applications, and microfluid devices that monitor and control chemical reactions.

NIST will use its facility to improve metrology by fabricating micrometer and nanometer scale devices. For example, in principle it will be possible to measure magnetic forces at the level of 10^{-18} N using MEMS magnetometers. This is equivalent to the force it takes to flip a single proton magnetic spin.

One goal of this project is to develop imaging technologies to examine nanometer-scale magnetic phenomenon. This project also will integrate tiny thin-film devices into MEMS magnetometers that can measure very small magnetic moments and then can be discarded. Such devices are desired by the data storage industry for deposition and process monitoring.

Other applications include developing thermal-isolation thin-film membranes for x-ray and infrared detectors and ultrasensitive microcalorimeters. In addition, NIST plans to use the MEMS facility to fabricate microstructures to electromagnetically trap ions. By using precisely etched silicon planes for electrodes, some unwanted heating effects in present traps may be eliminated.

For more information about the MEMS facility, contact James Beall, (303) 497-5989.

Media Contact: Fred McGehan, (303) 497-3246; mcgehan@boulder.nist.gov.

NEW STANDARD TO HELP ADVANCE PARALLEL COMPUTING

NIST has spearheaded a significant advance in parallel computing technology by coordinating work on a new standard that allows people to use computers produced by different manufacturers in a single network.

Parallel processing is a way to break up a computing problem into pieces that various processors—the brains of computing systems—can work on simultaneously. This approach produces phenomenal problem-solving speeds, allowing people to make calculations in a single week that previously would have taken a year. Scientists and engineers who require extremely complex calculations are the primary users of parallel computing.

The technology got a significant boost in the early 1990s when industry adopted a standard Message Passing Interface (MPI). MPI allows people to harness the power of more than one machine to work on a single calculation. The adoption of MPI led to significant advances, but users typically had to limit their parallel processing to machines produced by a single manufacturer.

The new standard, called the Interoperable Message Passing Interface (IMPI), allows researchers to create networks of machines made by many different manufacturers. Additionally, NIST has developed software that allows manufacturers and software vendors to test their products to assure that they comply with the IMPI standard. The test software program can be run over the Internet.

More than a dozen leading companies and research institutes contributed to the development of the new parallel processing standard.

The IMPI standard is available on the World Wide Web at <http://impi.nist.gov/IMPI/>. See also the previous issue of this journal, Vol. 105, No. 3 (2000).

Media Contact: Philip Bulman, (301) 975-5661; philip.bulman@nist.gov.

AGREEMENT STREAMLINES TELECOMMUNICATIONS PRODUCT APPROVALS

Certifying new telecommunications equipment as compliant with federal and foreign requirements to prevent radio-wave interference should be cheaper and faster because of a precedent-setting arrangement involving NIST, the Federal Communications Commission (FCC), and the American National Standards Institute (ANSI).

NIST is recognizing ANSI as a qualified accreditor of product certifiers that approve radio transmitters, telephone hand sets, and other radio-frequency and telephone-terminal equipment after testing to determine whether they satisfy FCC regulatory standards. Currently, 13 US product certifiers are accredited by ANSI for this role.

Since June 5, 2000, these organizations designated as Telecommunication Certification Bodies (or TCBs)—are able to compete for business generated by the approximately 6000 applications for product approvals that FCC now receives annually.

To help streamline its approval process and to prevent delays that can slow the introduction of new products in fast-changing markets, the FCC established the TCB program. It asked NIST to accredit TCBs or to recognize an accreditor of these product certifiers.

Rather than set up a new program for accrediting certification bodies, NIST chose to rely on the existing infrastructure in the private sector. It prescribed procedures and performance standards for recognizing organizations that accredit certification bodies offering services for telecommunications equipment. NIST then conditionally delegated to ANSI the authority for

accrediting TCBS. Final authority required formal review by NIST, which has now occurred.

For more information, contact Joe Dhillon, NIST, (301) 975-5521; Hugh Van Tuyt, FCC, (202) 418-7506; Stacy Leistner, ANSI, (212) 642-4931.

Media Contact: Mark Bello, (301) 975-3776; mark.bello@nist.gov.

SOFTWARE GIVES FIREFIGHTERS COMPUTERIZED VIEW OF DEADLY BLAZE

New NIST fire modeling computer software recently enabled District of Columbia Fire and Emergency Medical Services Department investigators to gain insight into a 1999 townhouse fire that claimed the lives of two DC firefighters and critically burned another.

As part of the investigation of the tragedy, fire safety engineers at NIST's Building and Fire Research Laboratory were asked to employ two just-released programs: the Fire Dynamics Simulator (FDS), which numerically models the movement of smoke and hot gases caused by fire, wind and ventilation systems; and Smokeview, which permits visualization of the data. The investigators asked NIST to model the fire behavior with the first floor sliding glass door fully closed (as existed during the fire) and with this door fully ventilated (as required by the fire department's standing operating procedures).

FDS calculations relied on specific timeline details contributed by fire investigators, townhouse measurements gained from a site visit by NIST staff, and the system's own database of material properties. Based on the FDS data, Smokeview's visualization of the actual fire indicated that an opening of the basement sliding glass doors provided outside air (oxygen) to a pre-heated, underventilated fire compartment, which then developed into a post-flashover fire within 60 seconds. It also showed that some of the resulting fire gases flowed up the basement stairwell with high velocity and collected in a pre-heated, oxygen-depleted first floor living room with limited ventilation. The second model scenario demonstrated that differences in ventilation could have significantly changed fire conditions in the first floor area where the firefighters were operating.

The FDS and Smokeview programs, as well as the NIST report on their use in modeling the DC fire, may be downloaded from the World Wide Web at www.fire.nist.gov.

Media Contact: John Blair, (301) 975-4261; john.blair@nist.gov.

GROUND BROKEN FOR WORLD'S PREMIER METROLOGY RESEARCH LAB

Perhaps one of the most significant milestones in the nearly 100-year history of NIST occurred on June 9, 2000, when ground was broken in Gaithersburg, MD, on the Advanced Measurement Laboratory (AML).

When it is ready for occupancy in 2004, the 47 480 m², \$235.2 million AML will give NIST and its partners access to research and development capabilities not available anywhere else in the world. The laboratory's unique characteristics will yield higher quality reference materials, improved measurements and standards, and more rapidly developed research advances.

The AML will feature stringent controls on particulate matter, temperature, vibration and humidity that are unattainable in current NIST buildings. Such conditions are vital for housing the institute's most advanced metrology, physics, chemistry, electronics, engineering, manufacturing and materials science research.

The AML will consist of five lab sections: two below ground (for improved vibration isolation and temperature control), two above ground and one ultraclean room wing above ground. Specialty areas within the AML include 48 precision temperature control laboratories (constant temperatures within ± 0.1 °C or ± 0.01 °C depending on need) and 27 extremely low-vibration laboratories.

Characteristics that will be uniform throughout all of the AML lab modules are: HEPA (high efficiency particulate arresting) filtration for all laboratory air; a baseline temperature control of ± 0.25 °C; mechanical, electrical, and structural systems designed to minimize vibration; and a power system rated for critical electronic loads. Mechanical services (piping, ventilation and electrical) as well as laboratory support equipment (such as gas canisters) are located in a service corridor located between laboratory modules, maximizing flexibility and cleanliness.

Finally, natural daylighting, energy conservation and recycling are incorporated into the "green" building design and planned operation of the AML.

For more details on the AML, including graphics and artist renditions, go to the World Wide Web at www.ta.nist.gov/public_affairs/releases/aml.htm.

Media Contact: Michael E. Newman, (301) 975-3025; michael.newman@nist.gov.

NEW PUBLICATION HELPS FIND STATE PROGRAMS FOR TECH GROWTH

State and local governments have long understood the importance of fostering start-up companies and small firms to promote economic growth and development. Over the years, they have developed a network of services and programs for the entrepreneur, ranging from assistance with siting, business financing and workforce development to help in the development, commercialization and diffusion of new technologies, and in building manufacturing capabilities to advance their local economies.

To help small technology-oriented companies find their way through the maze of offerings to the services best suited to their needs, the NIST Advanced Technology Program has produced a roadmap. *A Guide to State Business Assistance Programs for New Technology Creation and Commercialization* is the first volume of two on “Reinforcing Interactions Between the ATP and State Technology Program.” Written by policy researchers at Johns Hopkins University, the new guide discusses how different types of business support programs are targeted at different phases of the technology development cycle and address different issues from actual R&D to business planning and marketing strategies. Multiple examples are provided of typical programs in different states, and an appendix gives a state-by-state catalog of programs with contact information.

Copies of *A Guide to State Business Assistance Programs for New Technology Creation and Commercialization* (NIST CGR 00-788) are available from the Advanced Technology Program, (301) 975-4332 or on the World Wide Web (as a pdf file) at www.atp.nist.gov/atp/pubs.htm.

Media Contact: Michael Baum, (301) 975-2763; michael.baum@nist.gov.

NEW NOISE MEASUREMENT SYSTEM NOW IN SERVICE AT NIST

Manufacturers of electronic components and systems used in the 4 GHz to 12 GHz range, such as telecommunications gear, satellite receivers and amplifiers, cellular phones and radar equipment, now have access to an improved service at NIST for the measurement and calibration of noise temperature.

A new calibration system just placed in service, which includes an automated coaxial (GPC-7) radiometer, will provide faster, more economical measurements at multiple frequencies. The system uses a vector network analyzer to measure reflection coefficients and

asymmetries, and stores them in a lookup table. The new strategy is much faster than using six-port reflectometer measurements.

A description of the new system and its uncertainty analysis has just been published as NIST Technical Note 1518, *Design and Testing of NFRad: A New Noise Measurement System*. To obtain a copy of TN 1518, contact Chriss Grosvenor, MC 813.01, NIST, Boulder, CO 80303-3328; (303) 497-5958.

Media Contact: Collier Smith, (303) 497-3198; smithen@boulder.nist.gov.

NEW NIST REFERENCE DATA FOR ELECTRON INTERACTIONS USED BY SEMICONDUCTOR INDUSTRY

NIST researchers recently completed the development of a new set of standard reference data for electron interactions with sulfur hexafluoride (SF₆). SF₆ is an important industrial gas used for many applications ranging from high voltage insulation to airplane tire inflation. It is also a commonly used plasma etching gas and is known to be a potent global warming gas. For these reasons reliable data on electron interactions with SF₆ are essential to industry. Interestingly, while SF₆ has been studied extensively (the data assessment utilized 348 published references), there are still significant uncertainties in the cross sections for many of the electron collision processes. Additionally, the NIST assessment indicated that many of the previously published, and commonly used, cross section sets were in significant error.

The new NIST reference data have been used by the plasma modeling group of a private company to improve their models of deep silicon etching. The new data resulted in better calculations of ion and radical densities, and the new calculated results are in the process of being further validated using experimental ion-flux measurements being performed at NIST.

CONTACT: James K. Olthoff, (301) 975-2431; james.olthoff@nist.gov.

OPTICAL DIELECTRIC FUNCTION DATABASE FACILITATES COMPOUND SEMICONDUCTOR MATERIAL QUALITY CONTROL

A NIST researcher is providing for the first time, data on the optical dielectric function of epitaxial thin films of compound semiconductors at growth temperatures. These data, measured using in situ spectroscopic ellipsometry, make it possible to reliably determine the composition and thickness of these thin films in

real-time, during the growth by molecular beam epitaxy. Unlike silicon, wafers of compound semiconductors combine layers of more than one element and are more difficult and expensive to fabricate. Therefore, materials suppliers must rely on methods of real-time analysis to detect flaws early in the process, before more costly device fabrication takes place. Conventional in situ techniques based on electron diffraction decay exponentially in time and, therefore, cannot be used in real-time throughout the growth.

At the request of a private company, NIST provided the optical dielectric function data for distribution in their commercial ellipsometry software package, which contains a dielectric function database for a wide range of materials including semiconductors, metals, and oxides. Availability of the data, which incorporates composition and temperature dependence, makes it possible for the first time to determine reliably the composition, temperature, and thickness in real-time during the sequential growth of each layer. NIST's contribution to this ever expanding dielectric function database is enabling vendors of ellipsometer equipment to impact broader telecommunications and high-performance electronics markets, which depend on low-cost availability of complex multilayered compound semiconductor heterostructures. Continued product maturity and introduction of the software into commercial markets are expected to leverage impact of the NIST database in industry at large.

The NIST researcher measured the in situ optical dielectric function of pseudomorphic InGaAs thin films, which are critical elements of high-performance transistors called pHEMTs. pHEMTs are composed of InGaAs, AlGaAs, and GaAs thin film stacks, each only nanometers thick and laced with low levels of various dopant atoms. pHEMTs are especially useful for low-noise amplifiers and power amplifiers at high frequencies (>1 GHz) and are ubiquitous in the expanding wireless markets, including cellular telephones, global positioning systems, satellite TV, and military electronics. Also measured was the in situ optical dielectric function of low-temperature-grown GaAs (LT-GaAs), which has applications in terahertz spectroscopy and high-speed oscilloscope applications.

CONTACT: Joseph Pellegrino, (301) 975-2123; joseph.pellegrino@nist.gov.

NIST RELEASES NON-BLOCKING VERSIONS OF MESSAGE PASSING INTERFACE (MPI) DATA-TYPE TOOLS

The popular MPI Data-Type tools, AutoMap and AutoLink, at <http://www.nist.gov/itl/div895/savg/auto/>, now have non-blocking versions. AutoMap is a tool

designed to simplify the creation of MPI data-types. It works as a source-to-source compiler reading directly from user type definitions in C to create the MPI data-types automatically. AutoLink is a tool designed to transfer dynamic data-types with pointers (like graphs) using MPI. It works as a library, giving the user access to high-level functions to transfer the dynamic data-types. It can transfer dynamic data-types with heterogeneous nodes. With the new release, users can do both blocking and non-blocking sends and receives. AutoMap and AutoLink can be downloaded and run, or AutoMap can be run directly from the web page.

CONTACT: Martial Michel, (301) 975-3866; martial.michel@nist.gov or Judith Devaney, (301) 975-2882; judith.devaney@nist.gov.

NIST-SEMATECH SCIENTISTS UNRAVEL THE STRUCTURE OF NANOPOROUS THIN FILMS

Collaboration among researchers at SEMATECH and NIST led to development of new metrology to characterize the structure of nanoporous thin film low-*k* dielectrics for use in next generation integrated circuits. Over the 2 year period of collaboration, 25 different types of candidate films have been characterized successfully with results distributed to the member companies of SEMATECH to support efforts in developing low-*k* dielectrics.

As integrated circuit feature sizes shrink, new low-*k* dielectric materials are needed to address problems with power consumption, signal propagation delays, and cross-talk between interconnects. One avenue to low-*k* dielectric materials is the introduction of nanoscale pores into a solid film to lower its effective dielectric constant. However, the pore structure of these low-*k* dielectrics strongly affects other important material properties, such as mechanical strength, moisture uptake, coefficient of thermal expansion, and adhesion to different substrates. The characterization of the pore structure also is needed to guide development of future low-*k* materials and processes.

Significant measurement challenges had to be surmounted in the development of metrology to characterize the pore structure of thin nanoporous low-*k* dielectric films. The small sample volume of 1 μm films and the need to characterize the film structure on silicon wafers imposed great challenges to traditional methods for characterizing porous materials. The newly developed NIST-SEMATECH methodology is based on a unique combination of high-resolution x-ray reflectivity and small-angle neutron scattering measurements. Average pore size, film density depth profile, porosity, pore connectivity, moisture uptake, and pore wall density may now be measured. The NIST-SEMATECH

methodology is currently the sole measurement technique able to determine the pore wall density directly correlated with mechanical integrity of thin films. The NIST measurement results have facilitated materials and equipment suppliers in the synthesis of a wide range of novel nanoporous films, including many having more complex structures. Work is now in progress to characterize these more complex structures by developing new strategies based upon this methodology. For example, recent developments have enabled characterization of nanoporous films with inhomogeneous wall structures. CONTACT: Wen-li Wu, (301) 975-6839; wen-li.wu@nist.gov or Eric K. Lin, (301) 975-6743; eric.lin@nist.gov.

EVALUATING FERROELECTRIC MATERIALS FOR MICROWAVE ELECTRONICS

As part of its program on electronic materials, NIST has collaborated with the University of Colorado in an investigation of new ferroelectric perovskite oxide thin films for cryogenic and ambient temperature applications. Thin-film ferroelectric materials have received considerable attention because of their growing use in electronic, electro-optic, optical, and acoustic devices. Potential applications include random access memories, pyroelectric detectors, acoustic transducers, and microwave devices. An important characteristic of these materials is the ability to change their dielectric constants by an externally applied electric field (non-linear dielectrics). This idea is being pursued in a class of novel tunable microwave devices such as microstrip line phase shifters, high- Q resonators, and tunable filters. These devices contain both high-temperature-superconducting film and non-linear dielectric film. The former provides low surface resistance and thus intrinsically narrow bandwidths and the latter allows for an easy change in resonant frequency because its dielectric constant is controlled by an external electric field. Of the various non-linear dielectric materials, ferroelectric perovskite oxide-thin films are considered potential candidates for tunable microwave devices because of the high dielectric constant. The team has just released a report on film growth, the structural and low-frequency dielectric properties of the films, and some dielectric data obtained on bulk samples. They also present results on X-ray diffraction studies on some of the films, which clarify the effect of strain on dielectric properties. CONTACT: Tom Siewert, (303) 497-3523; siewert@boulder.nist.gov.

NEW METHOD FOR MATERIALS MEASUREMENTS AT VERY HIGH TEMPERATURES

A significant number of refractory inorganic and ceramic materials undergo melting and vaporization transformations at very high temperatures, particularly over the range of 2500 K to 5000 K. However, virtually no direct thermochemical data are available for this range as conventional measurement methods are limited to temperatures below about 2500 K. NIST researchers have developed new measurement methods for determination of temperature, pressure, and vapor phase molecular composition at thermal equilibrium for this elevated temperature range. The methods utilize pulsed laser heating with in situ mass spectrometric and optical spectroscopic monitoring of pressure and temperature transients. Results have been obtained for the $\text{ZrO}_2\text{-Y}_2\text{O}_3$ system, for which partial pressure data are needed by the aerospace industry for thermal spray and electron beam processing of thermal barrier coatings. Related results obtained for other refractory materials such as C, Al_2O_3 , and SiC have been used to test the reliability of the critical evaluation and extrapolation procedures used to generate the widely used NIST-JANAF thermochemical tables. With this direct measurement approach, improvements in data reliability by an order of magnitude, or more, are found. Initial results of this work recently were presented at the 10th IUPAC Conference on High Temperature Materials Chemistry, in April 2000, Julich, Germany, and at a NIST workshop, in May 2000, on non-contact thermometry.

CONTACT: John W. Hastie, (301) 975-5754; john.hastie@nist.gov.

PHOTON EMISSION STM PROVIDES CHEMICAL CONTRAST MAP OF ORGANIC MONOLAYERS

NIST researchers have demonstrated that photon emission scanning tunneling microscopy (PESTM) is capable of resolving chemically heterogeneous features of organic monolayer surfaces with a spatial resolution of approximately 2 nm. Improved methods are needed for chemical composition mapping of surfaces in many diverse applications, including microelectronics, chemical sensor array technologies, and molecular electronics. In conventional STM, an electrically biased sharpened metal probe is scanned under feedback control over an electrically conducting surface. In PESTM,

photons emitted by either inelastic tunneling or radiative hot-carrier thermalization are collected along with the feedback signal creating a correlated topograph and photon map.

PESTM measurements were performed on gold surfaces coated with monomolecular-thick films comprising a phase-separated mixture of reduced and photo-oxidized alkanethiols. Contrast was observed in the photon maps and was correlated with the reduced and oxidized molecular domains in the topographs; however, assignment as molecule-dependent quantum yield could not be made without considering artifacts. For example, artifactual contrast could be obtained if the photon quantum yield was sensitive to tip-sample gap. To check for this, the photon yield was measured as a function of tip-sample gap over a range of 0.4 nm, a range large enough to account for all observed topographic features. The quantum yield was found to be nominally independent of tunneling gap width over this range, therefore indicating that the observed spatial photon contrast was, in fact, due to molecule-dependent quantum yield. This study indicates that PESTM may be a viable technique to discriminate between molecular species on molecularly heterogeneous surfaces with nanometer spatial resolution.

CONTACT: Gregory Poirier, (301) 975-2603; gregory.poirier@nist.gov.

FASTER ALGORITHM ALLOWS IMPROVED SIMULATION OF SINGLE ELECTRON PUMPS

A NIST researcher has been developing computer programs for the calculation of error rates in multi-junction single electron tunneling (SET) pumps since 1997. The electron pump is a critical component of the new SET-based capacitance standard and detailed modeling of the error mechanisms is a critical step to understanding and improving the performance of the pump. As more types of tunneling events and more possible states of the device were included in the calculations, the time to simulate pumping under typical operating conditions became quite long. For some cases the time to calculate the error rate for a seven-junction pump at a particular temperature and pumping rate was a few days. Kautz recently showed that large parts of a computation done early in the algorithm could be reused later in the algorithm. This reduced the time needed for the most complex cases to a few hours. This advance will allow a much wider range of parameters to be explored in a reasonable amount of time as work continues toward a more complete understanding of error mechanisms in electron pumps.

CONTACT: Richard Kautz, (301) 975-3391; kautz@boulder.nist.gov.

NEW NANOMETER-SCALE OPTICAL PROBES DEVELOPED

Scientists who operate the Magneto Raman Scattering Facility at NIST have been using “dendrimers” to develop nanometer-scale optical probes for biological processes. Dendrimers are well-defined polymeric molecules in the range from 1 nm to 15 nm; they have been studied for use in gene therapy and as means to deliver therapeutic genes in cancer cells. A novel synthetic procedure to produce 2 nm to 6 nm crystallites of materials for optical probes was developed recently, employing organic polymer dendrimers as nanostructure templates. Luminescence from cadmium-sulfide nanocrystals synthesized via this route is now being studied at the Magneto Raman Scattering Facility. In its bulk crystalline form, cadmium-sulfide does not exhibit luminescence because of its indirect energy band-gap. As nanocrystals, however, quantum confinement modifies its electronic structure, and luminescence of various colors has been observed, which confirms the existence of such quantum effects. The structure of this new class of organic-inorganic hybrid materials also is being investigated by Raman scattering spectroscopy. This research could lead to the exciting possibility of allowing one to introduce nanocrystals as luminescent probes to study various chemical and biological systems. CONTACT: Danilo Romero, (301) 975-3733; danilo.romero@nist.gov or Raju Datla, (301) 975-2131; raju.datla@nist.gov.

30 YEARS OF PRECISION MEASUREMENT GRANTS

Summer 2000 marks the 30th anniversary of the NIST Precision Measurement Grants (PMG) program. The program was established in 1970 by then NBS Director Lewis M. Branscomb at the suggestion of James Faller, then a physics professor at Wesleyan University, and now chief of one of NIST’s divisions. The PMGs are awarded to faculty members of U.S. colleges and universities for significant, primarily experimental research in the field of measurement science or the determination of fundamental constants. Currently each grant is for the amount of \$50 000 per year, renewable for up to 2 additional years. NIST sponsors these grants to encourage basic, measurement-related research at the Nation’s foremost schools of higher learning, and to foster contacts between NIST scientists and those faculty members who are actively engaged in such work. Since its inception 30 years ago, 66 PMGs have been awarded to outstanding scientists working on challenging and important research projects.

Indeed, two grantees have received a Nobel Prize in Physics subsequent to their 3-year grant periods: Steven Chu of Stanford University shared the 1997 Prize for his work on laser cooling and trapping of neutral atoms, and Daniel C. Tsui of Princeton University shared the 1998 Prize for his co-discovery of the fractional quantum Hall effect. Grant recipient Carl Wieman, now at the University of Colorado, shared the prestigious 1997 King Faisal International Prize in Science, along with NIST scientist Eric A. Cornell, for their 1995 creation of a Bose-Einstein condensate in a system of neutral atoms. NIST researcher William D. Phillips, who shared the 1997 Nobel Prize in Physics with Chu and a French scientist, was a student of one of the first recipients of a PMG, Daniel Kleppner of the Massachusetts Institute of Technology. In fact, Phillips received his Ph.D. under Kleppner for his contributions to the experiment for which Kleppner was awarded his 1970 grant. While no guarantee exists that such recognition for scientists (or their students) who have received a grant will continue in the future, it would certainly come as no surprise. CONTACT: Barry N. Taylor, (301) 975-4220; barry.taylor@nist.gov.

ISO WORKING GROUP MEETS AT NIST

The second meeting of ISO/TC 201/SC 8/WG 1 was held in May 2000, in the Advanced Chemical Sciences Laboratory on the Gaithersburg campus. ISO/TCT201/SCT8/WGT1 is the Characterization of Coatings Working Group, which is part of the Glow Discharge Spectrometry Subcommittee under the ISO Technical Committee on Surface Chemical Analysis. Delegations from Sweden, Japan, China, Australia, and the United States were in attendance. The meeting was organized and hosted by a NIST scientist who has served as the United States delegate since 1994.

This particular ISO working group is concerned with writing standards for the characterization of coatings by glow discharge optical emission spectrometry (GD-OES). This analytical method enables the full elemental composition of coated surfaces to be determined as a function of depth relatively rapidly and inexpensively. GD-OES is still fairly new. Few national standards and only one international standard presently exist; therefore, the development of new documentary standards is very important for the further implementation of GD-OES.

The most prevalent industrial application of GD-OES to date is the characterization of galvanized and similar coatings on steels and other metallic substrates, serving

primarily the automotive and home appliance industries. Consequently, this is the subject of the first international standard method being developed by the working group. This standard method is entitled “Surface Chemical Analysis—Determination of Chemical Composition and Thickness of Zinc-and/or Aluminum-Based Metallic Coatings by Glow Discharge Optical Emission Spectrometry.” Much progress on the further development of this particular standard method was made during the 2 day meeting at NIST. The standard is expected to be published sometime in 2002.

CONTACT: Michael Winchester, (301) 975-3886; michael.winchester@nist.gov.

SUMMER SCHOOL ON NEUTRON SMALL-ANGLE SCATTERING AND REFLECTOMETRY

The NIST Center for Neutron Research (NCNR) held its sixth annual Summer School on Neutron Scattering at the center in June 2000. The course this year focused on the complementary techniques of small-angle neutron scattering (SANS) and neutron reflectometry (NR) and was intended to provide potential new users of these techniques with a basic understanding of the fundamental concepts and methodology along with training in the use of the SANS and NR facilities at the NCNR. An enthusiastic group of 32 graduate students and postdocs, predominantly from university chemical engineering and materials science departments, heard lectures by NCNR staff that were reinforced by demonstrations at the NCNRs two 30 m SANS instruments and two reflectometers and a tour of the entire facility. Part way through the week, the attendees were grouped into teams to acquire and analyze data on samples prepared by staff members to illustrate specific concepts covered in the lectures. Additional lectures on applications of the two techniques drawn from recent research in polymer science, complex fluids, magnetism, and structural biology were intermingled with the hands-on sessions at the instruments. The course closed with a session in which representatives from each team presented their experimental results to the whole class and staff, which prompted several lively discussions. Comments received throughout the week and on the course evaluation forms indicated that the course was successful in enabling the attendees to assess the applicability of neutron scattering to their own research interests.

CONTACT: Charles Glinka, (301) 975-6242; charles.glinka@nist.gov.

NIST HOLDS FIRST DISLOCATION CONFERENCE OF THE CENTURY—DISLOCATIONS 2000

In June 2000, 150 scientists from 20 countries converged on NIST to track progress in understanding of dislocations, which are the crystal defects which account for the permanent, or plastic, deformation behavior of metals. New large-scale computer simulations combined with new observational and measurement tools, many developed at NIST, recently have spurred a renaissance of theoretical treatments and predictions of dislocation behavior. The conference, jointly sponsored by NIST and the Pacific Northwest National Laboratory, provided a forum to hear about all these new developments and encourage worldwide collaborative research efforts. Most of the research in this area ultimately is aimed at developing more predictable and precise metal forming processes. The results of the conference will be used to direct and focus NIST's own metal forming projects to aid U.S. industry more effectively in the production of formed metal products. More than half the attendees were from outside the United States with France, Germany, and Japan heavily represented.

CONTACT: Lyle Levine, (301) 975-6032; lyle.levine@nist.gov.

NANOTRIBOLOGY WORKSHOP HELD AT NIST

A workshop on nanotribology was held at NIST in March 2000. The objective of the workshop was to critically assess the current state of the art of nanotribology in nanotechnology, microelectromechanical systems (MEMS), and mesomanufacturing. The workshop was sponsored by the National Science Foundation, Defense Advanced Research Projects Agency, NIST, Sandia, and the University of Maryland. About 100 participants from industry, academia, and government labs took part in the workshop. Thirty invited speakers from leading institutions in these technology areas came and spoke on the subjects of their expertise. Breakout sessions provided open forums for participants to suggest future research needs.

Nanotribology deals with the subject of adhesion, stiction, friction, and lubrication at the nanometer scale. As components shrink in size, adhesion and stiction become an increasingly important issue. Durability of moving parts in sensors, actuators, and accelerometers govern the component life. Means to control these issues are under active research both in industry and government labs.

Accurate and precise measurement methods of nanometer scale phenomena and microscale devices to measure nanometer components were identified by workshop participants as one of the key needs to further advancement in these technologies.

CONTACT: Stephen Hsu, (301) 975-6120; stephen.hsu@nist.gov.

ASTM MEMS STANDARDS COMMITTEE PURSUES NIST'S RECOMMENDATIONS FOR TWO NEW MEMS STANDARDS

As a result of a NIST researcher's extensive testing and analysis for the first MEMS Residual Stress Round Robin experiment, two new microelectromechanical systems (MEMS) metrology standards will be developed: one for linear dimensional metrology and one for out-of-plane static deflection measurements. Marshall was nominated by the ASTM committee to write these standards.

MEMS is a rapidly growing component of the semiconductor industry. A recent market study has shown MEMS to have an annual growth rate of 20 % to 30 % with total sales of components expected to exceed \$11.5 billion by 2003. These components will add value and functionality to larger systems such as automobiles, displays, data storage devices, optical routers, and biochips. MEMS technology integrates sensing (gathering of information) and actuation (acting on information) to the information processing functionality of the integrated circuit (IC); a fundamental next-step in integration of the IC.

Applications for MEMS demand high performance and reliability. For example, automobiles manufactured today contain MEMS sensor ICs to trigger the car's airbags in the event of a collision. The performance of this technology rests on the ability to make accurate measurements of device parameters and reliability. Although many different types of test structures and test methods have been developed, there are no standard test methods and no measurement uncertainty data. For this reason, measurements of MEMS device parameters such as residual stress and elastic modulus can have large variability depending on where the measurements were made.

The NIST MEMS project has been involved in the development of MEMS test structures since 1990. As a result of industry's need for measurement standards, a MEMS ASTM Task Group, E08.05.03, was formed recently to develop standard test methods for MEMS.

The group's first round robin experiment was carried out in the spring of 1999 for the measurement of residual stress. The experiment showed a wide variation in the measurement of residual stress that was attributed to the variation of dimensional measurements.

The MEMS project recognized the importance of dimensional metrology as a result of a test structures workshop that was held at NIST in 1997 and is now reinforced by the results of the first round robin experiment. In essence, it is critical to know the length and curvature of structures, such as cantilevers and beams, to correctly extract the device parameters of interest. The NIST researcher already has developed methods for dimensional measurements for the MEMS test structures that will form the basis of the new standards.

CONTACT: Michael Gaitan, (301) 975-2070; michael.gaitan@nist.gov.

NIST CO-ORGANIZES INTERDISCIPLINARY MEETING ON MATHEMATICAL ASPECTS OF MATERIALS SCIENCE

Personnel from NIST and the University of Minnesota, recently organized a successful conference entitled "Mathematical Aspects of Materials Science." The Society for Industrial and Applied Mathematics, which is the primary professional organization for applied mathematics in the United States, hosted the meeting in Philadelphia in May 2000. The National Science Foundation and the Department of Energy co-funded the event.

The highly interdisciplinary meeting brought together about 270 scientists from a wide spectrum of academic, government, and industrial laboratories in the United States and abroad. Eleven primary speakers discussed mathematical aspects of materials science applications, including epitaxial growth, contact line dynamics in thin films, micromagnetic modeling, anisotropic material properties, and the microstructure of sea ice. Each of 41 mini-symposia included four invited talks, 22 sessions of contributed papers, and a poster session. Seven NIST researchers participated, presenting or co-authoring talks on a number of subjects, including order-disorder transitions in binary alloys, diffuse interface models of phase transitions, and convective and elastic effects during solidification.

CONTACT: Geoffrey McFadden, (301) 975-2711; geoffrey.mcfadden@nist.gov.

NIST CO-SPONSORS FIRST INTERNATIONAL COMMON CRITERIA CONFERENCE

Six hundred participants from 23 nations gathered in Baltimore in May 2000 to participate in the First International Common Criteria Conference (ICCC). NIST, the National Security Agency, and the National Information Assurance Partnership co-sponsored the historic event. The conference brought together government and industry representatives from around the world to discuss the types of security features and assurances needed in commercial products for the systems and networks that will be employed within critical information infrastructures in the future. Conference highlights included the signing of the International Common Criteria Recognition Arrangement by the United States, Canada, Australia, New Zealand, the United Kingdom, France, Germany, the Netherlands, Finland, Norway, Italy, Spain, and Greece. The 13 nations agreed to accept the computer security testing results conducted in each other's accredited testing laboratories, thus greatly reducing the time and cost of security evaluations and increasing the availability of evaluated products for consumers.

Many of the world's leading information technology (IT) companies were represented at the ICCC with more than 45 vendors participating in the exhibit sponsored by the Federal Business Council. The employment of the Common Criteria as a standard security specification language by the IT industry was the central theme of the keynote speech.

Four distinct conference tracks provided a significant amount of information for attendees. Presentations from a variety of security testing and certification programs worldwide highlighted the importance of the Common Criteria on a global scale. Detailed technical presentations focused on the many difficult and challenging issues confronting specification writers and evaluators such as the composition issue and interpretations of security requirements. Government and industry representatives showcased the latest technology-based requirements captured in the form of protection profiles. These standardized sets of requirements addressed key technology areas such as operating systems, firewalls, network and telecommunications devices, database management systems, and smart cards. Comprehensive tutorial sessions provided detailed information on the Common Criteria, the Common Evaluation Methodology, and a new automated support tool for helping

consumers define their security requirements and IT manufacturers specify what they produced.

The Second International Common Criteria Conference will be held in Europe during the summer of 2001. The specific date and location will be announced in the near future.

CONTACT: Ron Ross, (301) 975-5390; ronald.ross@nist.gov.

NIST HOSTS TECHNICAL SEMINAR ON NETWORK SECURITY

In June 2000, NIST sponsored a NIST Technical Seminar entitled *The Good Guys Guide to Network Security Vulnerability and Penetration Testing*. About 50 government and industry professionals from the security, systems, and telecommunications fields attended the training course. The seminar focused on the relevant building blocks of a TCP/IP network and how they affect security, network management, and auditing objectives. Participants learned that the risk of network insecurity increases from the combination of two factors: the complexity and openness of client/server technology and Internet technologies.

CONTACT: Marianne Swanson, (301) 975-3293; marianne.swanson@nist.gov.

NIST CO-SPONSORS DIGITAL TV (DTV) SYMPOSIUM

NIST and the ANSI-affiliated National Information Standards Organization co-sponsored a leading-edge symposium on software support for the emerging field of interactive digital TV. Held in May 2000, at NIST, *DASE Symposium 2000: Foundations of Interactive Digital TV Application Software Environment* attracted 150 representatives from industry, government, academia, and foreign organizations. The event brought together the DTV industry players to promote commerce and provide an opportunity to learn about DASE technologies in a focused setting (<http://www.dase2000.nist.gov/>). Technical sessions focused on the DASE architecture, API (application programming interface) implementation, conformance, content, use of DASE, and related environments. NIST presented an overview of their open reference implementation of the DASE procedural APIs, which was developed at the request of the Advanced Television Systems Committee (ATSC) DASE Specialist Group. The NIST open reference version of DASE supports industry by providing platforms for DTV application development testing, DASE open source code, and a reference for verifying conformance tests.

Emerging interactive DTV unlocks exciting opportunities for broadcasters, content providers, tool developers, and equipment manufacturers. A result of converging broadcast, computer, and network technologies, DTV presents enormous potential for new, flexible services in expanded markets. Broadcasting will incorporate targeted TV advertising, video-on-demand, and interactive steering of presentations. E-commerce applications of the DTV appliance will provide home electronic banking, easy bill paying, and everyday shopping.

Not surprisingly, huge technical challenges accompany the fields enticing prospects. The ATSC/DASE specialist group sees their effort as enabling technology for interactive DTV applications. However, competing and potentially incompatible standards exist in Europe and other world regions. In addition, different, potentially incompatible standards are being used and developed by cable and digital satellite broadcasting interests. The middleware approach of the ATSC/DASE specialist group establishes a standard, extensible application software environment; this is appealing for downloadable software because it accommodates and abstracts a myriad of different lower-level standards. The DASE effort is a work in progress; it also contends with similar issues of compatibility with existing products that impose a de facto middleware environment, with other competing proposed standards, and with future content requirements. Such a standard environment fosters the interoperability concept of write-once, run-anywhere applications.

CONTACT: Alan Mink, (301) 975-5681; alan.mink@nist.gov.

NIST ASSISTS IN AIRFLOW MODELING OF LABORATORY FACILITY

NIST has worked with a private company to develop a multizone airflow model of a large laboratory nuclear facility at the Department of Energy's Savannah River site. This model was implemented in the multizone airflow and contaminant dispersal model CONTAM, developed by NIST's Indoor Air Quality and Ventilation Group. The effort was initiated to evaluate the airflow patterns existing in the facility and to evaluate the current operation of the building and ventilation systems and to assess potential modifications to support future missions. The model of the Savannah River facility is one of the most complex multizone systems ever analyzed with CONTAM or any other airflow model.

This laboratory facility includes three separate buildings and a large number of ventilation and filtration systems as well as extensive laboratory exhaust hoods

and clean room systems. NIST worked closely with the private company to develop the model of the facility and to support their analysis through the development of several new features within the CONTAM program. As a result of this interaction, an understanding of how the facility is “starved” for air based on the exhaust system airflows and how this situation is impacting critical airflow and pressure relationships in the facility. In addition, CONTAM was very effective in displaying the limitations of the current duct system configuration and in revealing that the facility will require extensive duct modifications to support proposed exhaust hood additions and modifications.

CONTACT: George Walton, (301) 975-6421; george.walton@nist.gov.

UJNR MEETING HOSTED BY NIST

In May 2000, NIST hosted a delegation of 14 researchers from Japan for the 32nd Joint Meeting of the U.S.-Japan Cooperative Program in Natural Resources (UJNR) Panel on Wind and Seismic Effects. The panel was established in 1969 to develop and exchange technologies aimed at reducing damage from high winds, earthquakes, storm surge, and tsunamis. NIST provides the U.S.-side Chairman and Secretary General and the Public Works Research Institute of Japan (PWRI) provides the Japan-side Chairman and Secretary General.

The joint meeting consisted of 4 days of presentation of technical papers, discussion, and Task Committee meetings. The United States led a technical site tour to Puerto Rico to visit the construction of a light rail rapid transit system (Tren Urbano) in San Juan, two dams built by the U.S. Army Corps of Engineers near Ponce, and the 305 m diameter Radio Telescope at the Arecibo Observatory.

CONTACT: John L. Gross, (301) 975-6068; john.gross@nist.gov.

NIST HOLDS WORKSHOP ON METROLOGY AND MODELING OF COLOR AND APPEARANCE

Members of the NIST Measurement Science for Optical Reflectance and Scattering Competence Project recently organized a workshop on Metrology and Modeling of Color and Appearance. This workshop was held in March 2000, and addressed current and future needs for improving the fundamental understanding of factors affecting appearance, standard measurement protocols and artifacts, and predictive computer render-

ing based on optical scattering from objects. For many materials and products, appearance attributes are key to the final acceptance of the product.

The workshop was well attended and featured presentations from diverse industries such as color and appearance instrument manufacturers; coatings, textile, automotive, and aerospace industries; and universities and other government agencies as well as NIST staff. Additional information may be found at the Measurement Science for Optical Reflectance and Scattering web site at <http://ciks.nist.gov/appmain.htm>.

CONTACT: Maria Nadal, (301) 975-4632; maria.nadal@nist.gov or Mary McKnight, (301) 975-6714; mary.mcknight@nist.gov.

WORKSHOP ON ESTIMATING UNCERTAINTIES FOR LOW-LEVEL RADIOCHEMICAL ANALYSES HELD AT NIST

In May 2000, the Council on Ionizing Radiation Measurements and Standards, in collaboration with the Department of Energy, Office of Environmental Management, and NIST conducted a workshop on estimating uncertainties for low-level radiochemical analyses. The purposes of the workshop included the development of measurement models, establishment of a consistent protocol for estimating combined uncertainties, and development of project-specific examples of combined uncertainties. Participants in the workshop included 21 representatives from standards laboratories, regulatory and monitoring agencies, commercial laboratories, and armed forces and national laboratories that are conducting a diverse array of activities such as mass spectrometry, radiobioassay, environmental remediation, waste management, and safeguards. Measurement needs in these specialty areas have become increasingly demanding and are pushing the limits of detection for current ionizing radiation detectors.

CONTACT: Kenneth G.W. Inn, (301) 975-5541; kenneth.inn@nist.gov or John Fassett, (301) 975-4109; john.fasset@nist.gov or Mark Levenson, (301) 975-2848; mark.levenson@nist.gov.

NIST PARTICIPATES IN EUV-LLC ADVISORY BOARD MEETING

A NIST physicist was invited to participate in the Advisory Board Meeting of EUV-Limited Liability Corp. (EUV-LLC) in Santa Clara in June 2000. EUV-LLC was established in 1995 to accelerate the development of extreme ultraviolet (EUV) lithography, a

leading contender for the next-generation lithography tool for microcircuit fabrication.

The concept of using EUV radiation (radiation with a wavelength of about 10 nm) for lithography originated about 10 years ago, after researchers demonstrated that multilayer optics could achieve high normal-incidence reflectivities in the EUV spectral region. At that time, NIST began a competence initiative to establish the necessary capabilities for EUV optical metrology. This action resulted in the establishment of the NIST/DARPA National EUV Optics Facility at the NIST SURF synchrotron, which serves the measurement and standards needs of the EUV lithography community. In collaboration with the Lawrence Livermore, Sandia, and Lawrence Berkeley National Laboratories, EUV-LLC has instituted a large-scale, ambitious research program, with the goal of facilitating the development of a workable system by the middle of this decade. A prototype tool, the Engineering Test Stand, is scheduled to be operating by early 2001.

CONTACT: Charles Clark, (301) 975-3709; charles.clark@nist.gov.

Standard Reference Materials

NEW STANDARD REFERENCE MATERIAL DEVELOPED FOR THE LUBRICANTS INDUSTRY

SRM 1848, “Lubricant Additive Package” is a new reference material that will be used to facilitate chemical measurement traceability for crankcase lubricating oil measurements. On the order of 750 million gallons of motor oil are sold and reprocessed in the United States each year. The American Society for Testing and Materials (ASTM) maintains a variety of motor oil test methods for the petroleum industry that rely on quality reference materials. Hundreds of laboratories in the United States and around the world use these methods for product development and manufacturing quality control. This SRM is the world's first certified reference material to support measurements of active ingredients in motor oils formulated to meet current and future automotive engine needs. According to the chair of ASTM D02.SC3 Subcommittee on Elemental Analysis, “this material was needed for a long time in the oil additives industry as a reference material for use in standardization of instruments used in such analyses.”

SRM 1848 is representative of commercial additive packages for passenger car motor oil that, in general, include a range of elements (e.g., B, N, Na, Mg, Si, P, S, Cl, Ca, Cu, Zn, Mo, and Ba). Certification was done in collaboration with five U.S. and European additive package manufacturers, who analyzed the SRM according to their standard operating procedures. At NIST, prompt gamma activation analysis, isotope dilution thermal ionization mass spectrometry, inductively coupled plasma atomic emission spectrometry, and x-ray fluorescence (XRF) spectrometry were used. In addition to elemental composition, a reference value was provided for “total base number” (TBN), an important measure of the oil's ability to neutralize harmful acids formed by internal combustion processes. TBN was determined by the collaborating labs using ASTM methods D 2896 and D 4739.

An additional benefit of NIST work on the project has been development of a method to improve the accuracy of XRF determinations of Mg used in detergent compounds in oils. This NIST method, which uses Al as an internal standard, will be offered to ASTM D02 Subcommittee 03 on Elemental Analysis for inclusion in the next revision of Standard Method of Test D 4927. The NIST efforts in the development of this new SRM and XRF measurement technology were recognized with an Award of Appreciation from ASTM D02 Committee on Petroleum and Lubricants on June 28. CONTACT: John Sieber, (301) 975-3920; john.sieber@nist.gov.

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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