Volume 103, Number 4, July–August 1998
Journal of Research of the National Institute of Standards and Technology

News Briefs

General Developments

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

THIRTY-SIX COMPANIES APPLY FOR 1998 BALDRIGE AWARD

Thirty-six U.S. companies—up from 26 in 1997—including 15 large manufacturers, five service companies and 16 small businesses, have submitted applications for the 1998 Malcolm Baldrige National Quality Award, the nation's premier award for business excellence and quality achievement.

Many companies believe that applying for the award is beneficial, whether they win or not. "The Baldrige application process is a great business health check that forces a company to closely examine all of its business practices. Every company that applies is a winner," said the chairman of the Baldrige Award board of judges.

Applicants for the award must show achievements and improvements in seven areas: leadership, strategic planning, customer and market focus, information and analysis, human resource focus, process management, and business results. Every applicant receives an extensive feedback report highlighting strengths and opportunities for improvement.

Winners of the 1998 award are expected to be announced in November by President Clinton and Commerce Secretary William Daley after the award's examiners and judges make their recommendations.

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NIST TRAINING ON PRICE SCANNING ACCURACY BENEFITS CONSUMERS

To help improve the accuracy of price scanning by supermarkets, drug, department and home improvement stores, NIST weights and measures experts recently completed training for officials from 46 states. Consumers across the country will benefit by seeing fewer overcharges at checkout, while retail businesses will lose less revenue due to undercharging. From June 14-16, 1998, and June 21-23, 1998, the NIST Office of Weights and Measures trained state weights and measures inspectors in procedures for determining the accuracy of price scanners.

In 1996, the Federal Trade Commission, NIST, and the states conducted a study that found wide variations in accuracy and suggested how retailers could improve accuracy and how consumers could ensure they pay the proper price at checkout. The FTC and state inspectors advised the retail industry that there would be a follow-up study due to the problems detected and that a reasonable period of time would be given to allow industry to take corrective actions.

In preparation for the second study, NIST invited representatives from all state weights and measures offices to participate in training, and staff from 46 states accepted. The FTC provided assistance in the three-day training, which involved classroom instruction and hands-on activities. The first session was held at NIST in Gaithersburg, MD, the second was held in Nashville, TN.

Media Contact: Linda Joy (301) 975-4403; linda.joy@nist.gov.

INDUSTRY, GOVERNMENT TEAM UP FOR SEAMLESS, SECURE E-COMMERCE

NIST and 16 leading companies in the electronic commerce arena recently banded together to ensure their

products can communicate easily while providing a high level of security.

The group, formed as part of a cooperative research and development agreement, held its first technical meeting in June 1998, bringing together computer security experts from NIST and its private-sector partners, including leading software, telecommunications, computer security and credit card firms.

The collaboration marks an intensified effort to support a "public key infrastructure" (PKI) that will make e-commerce more secure. PKI is expected to bring the advantages of cryptography to consumers and businesses who do business over the Internet.

The current project builds upon previous work by NIST and industry partners to develop technical specifications that enable a variety of e-commerce PKI products and services to communicate seamlessly in the same way that telephone and Internet services offered by different companies can utilize a common network. The previous effort focused primarily on digital signatures, which can be used to verify the identity of parties involved in e-commerce. Digital signatures are critical to the growth of e-commerce because consumers and businesses alike want to "know" the parties they do business with and the signatures help each party to recognize the other one electronically.

The CRADA partners are focusing on issues such as enhancing the confidentiality of e-commerce PKI transactions and interoperability, which assures that products and services produced by a variety of companies can communicate over a common network.

For technical information, contact Donna Dodson, Building 820, Room 418, NIST, Gaithersburg, MD 20899-0001, (301) 975-2934, ddodson@nist.gov.

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

RESEARCHERS FIND COOL WAY TO MAKE LASER MEASUREMENTS

Researchers at NIST have built a new laser power and energy measurement system based on a commercial cryogenic radiometer. Designated the Laser Optimized Cryogenic Radiometer (LOCR), the NIST system will increase the accuracy to which the agency can calibrate optical power meters used with lasers.

Since 1967, NIST has built and maintained electrically calibrated calorimeters to calibrate laser power and energy detectors for a variety of industrial and defense customers. Because commercial laser power and energy meters have improved significantly in the last 10 years, customers now require lower uncertainties from NIST's calibration services. The combined standard uncertainty of measurements with electrically calibrated calorimeters is limited to 0.25 % because they are operated at room temperature. The new system, based on electrically calibrated cryogenic radiometers operating near liquid helium temperatures, eventually will provide laser power measurements with a combined standard uncertainty of 0.02 % or less and will provide traceability to the International System of Units (SI, the modern metric system), with improved accuracy for laser power and energy calibration services.

NIST compared the LOCR with its highest accuracy laser calorimeter and found that the two systems agree within 0.1 %. This means the LOCR may be used in the future to calibrate transfer standards for other calibration services, resulting in a lower calibration uncertainty.

More information is available from Sarabeth Harris, MS104, NIST, Boulder, CO 80303-3337, (303) 497-3237, sarabeth@boulder.nist.gov. Ask for paper no. 23-98.

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

ROUND IS MORE SOUND FOR UV WEATHERING OF MATERIALS

Once in a while it really does make sense to put a square peg in a round hole. A Chicago company recently signed an exclusive license to a NIST invention that tests a wide range of organic building and construction materials using a spherical chamber instead of the previously used cylindrical version. Many companies use ultraviolet chambers to induce artificial weathering of building and construction materials in order to estimate durability over long periods of time. However, these test results can be inconsistent and difficult to replicate.

Researchers at NIST produced a novel way to obtain better results by using integrating sphere technology. The spherical chamber has a reflective inner surface that scatters UV light evenly, producing a uniform field of radiation. The sphere can be outfitted with apertures, which allows adjacent chambers to receive precisely the same amount and intensity of UV light. This lets researchers test several different samples of the same material under precisely the same UV light conditions while independently controlling other factors such as temperature, humidity, and mechanical loading.

For technical information, contact Joannie W. Chin, B350 Building Research Building, NIST, Gaithersburg, MD 20899-0001, (301) 975-6815, joannie.chin@nist.gov.

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

TRAVELING KITS MAKE SCATTERING PARAMETER TRACEABILITY EASIER

To verify the accuracy of microwave scattering parameter data on vector network analyzers, companies often sent verification kits to NIST to obtain NIST-calibrated measurements. However, the customers then were faced with the task of comparing NIST's results to theirs in order to demonstrate traceability. Now, a new NIST microwave measurement service using "traveling verification kits" eliminates this step.

Instead of the previous procedure, customers measure one of NIST's kits in their environment and then send the measurement data back to NIST for analysis. A formal report from NIST compares their measurements to the agency's and details the uncertainty in the NIST assessment. Traveling verification kits are currently available for 3.5 mm (33 GHz), 2.92 mm (40 GHz) and 2.4 mm (50 GHz). A traveling kit for Type N (18 GHz) also will be added shortly.

Another benefit of the new measurement service is that the cost—at $2,000 per kit—is substantially less than for conventional measurements of customer-owned verification kits.

For more information, contact John Juroshek, (303) 497-5362, fax: (303) 497-3970, juroshek@boulder.nist.gov; or Denis LeGolvan, (303) 497-3210, fax: (303) 497-3970, legolvan@boulder.nist.gov.

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

FALL WORKSHOP FEATURES STATE OF THE ART IN OIL SPILL BURNING

Intentional burning is emerging as one of the best methods of reducing the damage caused by oil spills at sea. Burning removes petroleum residues quickly from the water surface, preventing the ecological destruction that would occur if these pollutants sink to the sea floor.

In 1985, NIST began studying the burning of crude oil spills in the marine environment in order to define the procedure's characteristics and document any effects on the surrounding water and air. Thirteen years later, NIST, under the sponsorship of the Department of the Interior's Minerals Management Service, will host a major workshop on state-of-the-art techniques for the burning of spilled oil. The workshop, to be held in New Orleans on Nov. 2-4, 1998, will emphasize environmental and human health concerns that arise from deliberate burning. The conference facility has limited space, so early registration is advised.

Register by Oct. 19, 1998, through Lori Phillips, B116 Administration Building, NIST, Gaithersburg, MD 20899-0001, (301) 975-4513, fax: (301) 948-2067, lori.phillips@nist.gov. Electronic registration is available on the World Wide Web at http://www.nist.gov/public_affairs/confpage/ 981102a.htm. For technical information, contact Nora H. Jason, A252 Polymers Building, NIST, Gaithersburg, MD 20899-0001, (301) 975-6862, fax: (301) 975-4052, nora.jason@nist.gov.

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NIST MACHINE TO AID IN MAKING BETTER ARTIFICIAL JOINTS

The material of choice for longer-lasting orthopedic implants—such as joint replacements for hips and knees—is ultrahigh molecular weight polyethylene paired with an alloy of cobalt and chromium, a combination that has proven to be durable and compatible with the human body. But even joints made from these components last only about a decade, prompting industry to search for better materials.

Innovative devices have been needed desperately to speed up the screening of new materials for orthopedic implants; it takes about 6 months for conventional equipment to simulate the natural wear of artificial hips. Such a long testing period results in higher research and development costs for companies trying to bring better products to market.

So, NIST and four companies teamed under cooperative research and development agreements to design and construct a new apparatus to do the job. The resulting machine can evaluate a diverse combination of materials, produce debris and changes in surface texture resembling the wear that implants get in the body, and can complete a screening in about 1 week.

Now that the device has been tested successfully, the next step in the industry/government collaborative effort (the CRADAs soon will be extended for 2 years) will be to use it to study how potential, alternative implant materials hold up under the effects of motion, environment, and a variety of stress-loading cycles that represent the physical routines of different people.

The four companies that supported the development of the accelerated wear device and intend to extend their CRADAs with NIST are part of the Orthopedic Accelerated Wear Resistance Consortium.

Potential new members for the consortium and others interested in learning more about the accelerated wear device should contact John Tesk, A143 Polymer Building, NIST, Gaithersburg, MD 20899-0001, (301) 975-6799, john.tesk@nist.gov.

Media Contact: Emil Venere (301) 975-5745; emil.venere@nist.gov.

PUBLIC INQUIRIES NUMBER NOW A SNAP TO REMEMBER

Members of the public, industry personnel and others with general questions about all aspects of NIST, its programs or publications now have an easier-to-remember, one-stop phone number at their service. The new General Inquiries line is (301) 975-NIST (975-6478). Electronic mail inquiries still may be sent to inquiries@nist.gov, while the number for faxed requests for information remains (301) 926-1630.

Media inquiries should be directed to the public affairs specialist who covers a specific NIST organizational unit, program or activity. For a current list of the Media Liaison Group members and their coverage areas, check out the World Wide Web at http://www.nist.gov/public_affairs/mediahp.htm.

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

NIST HELPS INSURERS EVALUATE YEAR 2000 PREPAREDNESS

Concern over the Year 2000 "computer bug" problem—the failure of a computer program or system because the "00" year designation is mistaken for "1900"—has many businesses seeking Year 2000 liability and business interruption insurance.

The insurance industry, in turn, wants to be able to evaluate how effectively companies are fixing the problem before issuing policies. A new industry/government project is meeting the need.

The project offers insurers a standardized way to measure how rigorously a given company is developing or converting its software systems to preclude computer system failures. Software diagnostics and testing experts from NIST provided technical advice at the request of a Stamford, CT, company that is leading the insurance industry's risk assessment efforts. A private software consortium is supporting the work.

NIST has developed a variety of projects designed to help both small and large companies in the Year 2000 conversion process. The projects are part of a larger effort that is being coordinated by the President's Council on the Year 2000 Conversion.

For technical information on the Year 2000 insurance project, contact Gary E. Fisher, Room 562, Building 820, NIST, Gaithersburg, MD 20899-0001, (301) 975-3275, gfisher@nist.gov. More information on NIST's Year 2000 programs (and free software) is available on the World Wide Web at http://www.nist.gov/y2k.

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OCTOBER WORKSHOP TO WRITE NEXT CHAPTER IN PUBLISHING

Several recent technological advances have converged in a way that makes electronic books both technically and commercially feasible. Compared to conventional books, these hybrids combining the printed page and the computer take up less space, are more portable, last longer, and permit special editing features.

The rapid progress toward widely commercialized electronic books is due to manufacturers taking advantage of recent developments in information technology such as improved flat-panel displays and increased computer storage capacity. For example, touch screen display technology allows an electronic book reader to touch an unfamiliar word to get an immediate dictionary definition, make the print larger or smaller, or highlight a section without the use of a yellow marker.

To help the emerging industry get off to a solid start, NIST will host the first meeting in history to bring together publishers, portable storage manufacturers, display manufacturers, touch-screen manufacturers, online booksellers, information technology experts, teachers, electronics executives, and others involved. The workshop's goal is to illustrate the capabilities of hand-held electronic books and identify issues that must be addressed for their successful commercialization. Topics to be discussed include electronic book concepts and prototypes, software and interfaces, storage/content providers, standards and interoperability concerns, and application of flat-panel displays for electronic book readers.

"Electronic Book '98 Workshop: Turning a New Page in Knowledge Management" is being co-sponsored by NIST and the Video Electronics Standards Association, at NIST's Gaithersburg, MD, headquarters on Oct. 8-9, 1998.

Register through Lori Phillips, B116 Administration Building, NIST, Gaithersburg, MD, 20899-0001, (301) 975-4513, fax (301) 948-2067, lori. phillips@nist.gov. Electronic registration is available on the World Wide Web at http://www.nist.gov/public_affairs/ confpage/conffutr.htm. For technical information, contact Victor McCrary, A263 Technology Building, NIST, Gaithersburg, MD 20899-0001, (301) 975-4321, victor.mccrary@nist.gov.

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PARTNERSHIP FOR COMPETENT LAB ACCREDITATION NOW INCORPORATED

The National Cooperation for Laboratory Accreditation (NACLA), a voluntary private/public partnership established to provide coordination, recognition and worldwide acceptance of competent laboratory accreditation, has been incorporated as a non-profit organization in the District of Columbia.

The new corporation's vision is "a test or calibration performed once and accepted worldwide." To accomplish this goal, NACLA will seek to end redundancy of multiple accreditations (both domestically and internationally), reduce accreditation costs for all parties and support the move to one-stop shopping. NACLA will develop and administer recognition procedures to be accepted by all of its members in the United States and North America, and to serve national and international needs in laboratory accreditation.

NACLA's creation was the result of a three-year collaborative effort of laboratories, accreditation bodies, Federal and state agencies, industry, and other interested groups. Coordinating the development stage was the Laboratory Accreditation Working Group, sponsored by ACIL (formerly the American Council of Independent Laboratories), the American National Standards Institute and NIST.

Now that the organization has been incorporated, the next milestone for NACLA will occur later this year when a nominating committee recommends a slate of candidates for the organization's first elected board of directors. Voting for the slate by the full NACLA membership will take place at the partnership's first national meeting in late 1998 or early 1999.

For more information on NACLA membership and activities, contact Fred Grunder, American Industrial Hygiene Association, (703) 849-8888, or Cathleen Trail, NIST, (301) 975-4462. Interested parties also should visit the NACLA World Wide Web site at http://ts.nist.gov/ts/htdocs/210/nacla/index.htm.

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BIPOLAR VOLTAGE SOURCE DEVELOPED FOR AC AND DC METROLOGY

Scientists at NIST have developed an accurate bipolar voltage source for use in alternating and direct current metrology, based on the quantized pulses of Josephson junctions. The device has potential applications in the generation of digitally synthesized ac signals with calculable rms (short for root-mean-square) voltages, the characterization of digital-to-analog and analog-to-digital converters, and in the calibration of dc and ac reference standards and voltmeters.

In a paper delivered recently at the Conference on Precision Electromagnetic Measurements in Washington, DC, the NIST researchers presented experimental progress toward realizing a quantum mechanically accurate voltage source for ac and dc metrology. They described a new method of generating bipolar waveforms with an array of Josephson junctions by driving the array with a combined input waveform consisting of a two-level broadband digital code and a single frequency sinusoidal drive. This new method provides a sixfold increase in output voltage compared to the voltage of previous unipolar waveforms. As described in the paper the accuracy of this source is based on the fact that Josephson junctions generate voltage pulses whose time-integrated areas are perfectly quantized. Appropriate sequences of these quantized pulses can be used to generate ac and dc waveforms with precisely calculable rms voltage.

For a copy of the paper, contact Sarabeth Harris, MS 104, NIST, Boulder, CO 80303-3337, (303) 497-3237, sarabeth@boulder.nist.gov.

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

NIST TO STEP INTO NEW ROLE

Now that efforts to develop global product data exchange standards have attained self-sustaining "international momentum," NIST has begun to shift out of its 15-year-long role as secretariat of the body guiding the evolution of STEP, the global *S*tandard for the *E*xchange of *P*roduct model data.

In a letter, NIST recently advised the American National Standards Institute that it intends to relinquish its role as administrator of manufacturing and enterprise integration standards in order to focus on its technical contributions to these standards instead. As the U.S. member of the International Organization for Standardization (known as ISO), ANSI named NIST in 1984 as the secretariat for the ISO Subcommittee on Industrial Data. ANSI is expected to re-assign the secretariat to a different organization by October 1999.

The quest to create a universal, unambiguous language for exchanging product information among computers grew out of NIST manufacturing research. STEP officially adopted as ISO 10303 in 1994—has committed implementations from all of the top 10 vendors of computer-aided design systems. Major automotive and aerospace manufacturers have adopted STEP-based technologies and are spreading them to their supply chains.

The subcommittee also works on standards in support of parts libraries, manufacturing management data, and oil and gas industry data, with more than 250 people

now meeting quarterly to continue this development. In order to further the evolution and increase the capabilities enabled by these standards, NIST will continue to develop testing methodologies and make other technical contributions to the standards.

For more information, contact Lisa Phillips, (301) 975-5021, lisa.phillips@nist.gov; or Steven Ray, (301) 975-3524, steven.ray@nist.gov.

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

WANTED: BALDRIGE AWARD EXAMINERS FOR 1999

NIST is looking for volunteers from a wide variety of business and not-for-profit organizations to serve a one-year term on the board of examiners for the 1999 Malcolm Baldrige National Quality Award.

"There is prestige and pride associated with being a Baldrige examiner. You gain external recognition and validation while contributing to a national program that seeks to improve U.S. competitiveness in all sectors," said a regional quality officer and a Baldrige Award senior examiner.

Examiners evaluate applications for the award, prepare feedback reports to applicants citing strengths and opportunities for improvement and recommend award winners to the NIST director. Qualifications include expertise in business, education or healthcare management processes and results and knowledge of practices and improvement strategies that lead to organizational excellence. The board consists of about 300 members, including nine judges and about 60 senior examiners.

If funding is approved by Congress, 1999 will be the first year that not-for-profit education and healthcare organizations will be eligible to apply for the Baldrige Award. Applications for the board will be available in November 1998.

Additional information is available by calling (301) 975-2036 or by visiting the Baldrige Award web site at http://www.quality.nist.gov/examr99/.

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

KECK FOUNDATION TO FUND OPTICAL LAB AT JILA

The W. M. Keck Foundation of Los Angeles has awarded a $962,000 grant to establish an optical measurement laboratory at JILA, a Boulder, CO, interdisciplinary institute for research and graduate education in the physical sciences operated jointly by NIST and the University of Colorado at Boulder.

Much of JILA's work involves the use of lasers, lenses, mirrors and other optical devices, so the new laboratory will provide a world-class resource for optical metrology. Scheduled to open in the summer of 1999, the facility—to be known as the W. M. Keck Optical Measurement Laboratory—also will play a critical role in improving the ability to use light to study the properties of the Bose-Einstein condensate, a fourth state of matter (created by supercooling atoms to near-absolute zero) first observed in 1995 at JILA.

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FACT SHEET HIGHLIGHTS PROGRESS ON NSMP PROJECTS

The semiconductor industry continues to introduce a dizzying array of manufacturing innovations, leading to smaller and more complex integrated circuits and electronic components. But these breakthroughs pose an obvious challenge: scientists and engineers must invent new ways to measure tiny dimensions and quantities, such as the dimensions of minuscule circuits, ultrathin layers of insulation and the power outputs of lasers. Without such measurements, new products cannot be tested accurately and characterized for commercial distribution.

To help American industry shoulder the research and development burdens associated with new measurement technologies, NIST launched the National Semiconductor Metrology Program in 1994. The program, managed by NIST was designed to meet the most critical measurement needs identified by industry, including those listed in the Semiconductor Industry Association's National Technology Roadmap for Semiconductors.

NIST published a progress report on six of the NSMP's current projects for the recent Semicon West '98 conference. The project summaries included are:

- Innovative Microscope Ready to Measure Industry Samples,
- NIST Enters Negotiations to License Revolutionary Microcalorimeter,
- New Reliability Testing Technique Saves Months of Time,
- Standard Reference Materials Improve Silicon Wafer Resistivity Testing,
- More Accurate Dopant Profiling Possible from Scope Images, and
- Ultra-Precise Tool for Calibrating Water-Vapor Detectors Unveiled.

The progress report is available by sending an e-mail message to media@nist.gov, faxing a request to (301) 926-1630 or directly at http://www.nist.gov/public_affairs/ factsheet/nsmp.htm. An overview of the NSMP may be found at http://www.eeel.nist.gov/810.01/nsmpover.html.

For further information, check out http://www.eeel.nist.gov/omp on the World Wide Web or contact Robert I. Scace, Office of Microelectronics Programs, A317 Technology Building, NIST, Gaithersburg, MD 20899-0001, (301) 975-4400, fax (301) 975-6513, nsmp@nist.gov.

Media Contact: Emil Venere, (301) 975-5745; emil.venere@nist.gov.

PROPOSALS SOUGHT FOR PRECISION MEASUREMENT GRANTS

NIST is seeking project proposals for two research grants for fiscal year 2000 in the field of precision measurement and fundamental constants. NIST Precision Measurement Grants are awarded each year to faculty members of U.S. universities or colleges for work in determining values for fundamental constants, investigating related physical phenomena or developing new, fundamental measurement methods. Each Precision Measurement Grant of $50,000 for one year may be renewed by NIST for up to two additional years for a total of $150,000.

Prospective candidates must submit summaries of their proposed projects and biographical information to NIST by Feb. 1, 1999. The application should include a pre-proposal summary of not more than five double-spaced pages outlining the objective, motivation and technical approach of the research and the amount and source of current funding for the research, together with a concise biographical sketch of the applicant and a list of the applicant's most important publications.

On the basis of this material, four to eight semi-finalists will be selected to submit more detailed proposals. Submit 10 copies of the pre-proposal summary to Barry N. Taylor, B161 Technology Building, NIST, Gaithersburg, MD 20899-0001.

For more information, contact Taylor at (301) 975-4220, or visit the Precision Measurement Grants World Wide Web page at http://physics.nist.gov/ResOpp/grants/grants.html.

Media Contact: Linda Joy, (301) 975-4403; linda.joy@nist.gov.

NIST VALIDATES FIRST FIPS 140-1 LEVEL 3 CRYPTOGRAPHIC MODULE

In May 1998 the SafeKeyper Signer, developed by a private company, became the first cryptographic module to be validated overall to Federal Information Processing Standard (FIPS) 140-1 Level 3, for use by Federal agencies. Until this time, the highest overall level obtained by a module was Level 2. Level 3 includes increased physical security with a tamper response mechanism and identity based authentication. In addition to the first module, NIST also validated the Entrust Cryptographic Kernel v3.1 developed by second company, as conforming to FIPS 140-1 Level 1. Both modules were validated as conforming to FIPS 140-1, Security Requirements for Cryptographic Modules. FIPS 140-1 specifies four separate levels of security provided by Cryptographic Modules, with each level providing increased security and assurance. These new validations bring the total number of validated products to 18 for NIST's Cryptographic Module Validation (CMV) program.

These new validations impact Federal agencies by greatly increasing the number of cryptographic products available for use in securing sensitive information.

The CMV program is a joint effort between NIST and the Communications Security Establishment (CSE) of the Government of Canada. NIST and CSE serve as the validation authorities for the program. Currently, there are three National Voluntary Laboratory Accreditation Program accredited laboratories that test cryptographic modules.

In addition to the FIPS 140-1 validation efforts, NIST and CSE sponsored the first FIPS 140-1 conference on May 11-12, 1998. The conference was entitled "Assuring Cryptographic Security: Development, Validation and Use of FIPS 140-1 Compliant Products." The conference attracted more than 150 people; attendees included federal agencies, industry, the banking community, and a large international contingency.

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

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NIST MODEL BOOSTS CMM ACCURACY

In an April 1998 cover story, Quality Magazine featured research on coordinate measuring machines (CMMs) performed by NIST. This article, entitled "NIST Model Boosts CMM Accuracy," highlighted the recent release of a touch-trigger probe error modeling software called SuperFit. While touch-trigger probes are economical and popular, measurements performed using them are affected by errors that manifest themselves as lobes on what otherwise would be a perfect sphere. SuperFit maps these errors for a particular CMM and compensates for them in measuring actual parts. Probe-lobing errors typically are reduced from more than 6 μm to less than 1 μm. This model offers manufacturers using these types of probes the ability to check shape and dimension far more accurately than with other methods. A copy of the article can be read on-line at qualitymag.com/articles/apr98/0498f7.html.

CONTACT. Steven Phillips, (301) 975-3565; steven.phillips@nist.gov or Tyler Estler, (301) 975-3483; tyler.estler@nist.gov.

VIRTUAL INSTRUMENT PROVIDES LOW-COST RF AND MICROWAVE DEVICE MEASUREMENT CAPABILITY, DRAWS SOFTWARE REQUESTS

Researchers at NIST have developed a virtual vector network analyzer for characterizing the microwave response of linear devices, which already has made an impact by providing a new tool for frequency-domain measurements. Their "instrument" combines a digital sampling oscilloscope with time-domain reflection/transmission capabilities, NIST time-domain network analysis software, and a commercial graphics-based instrument-control software package. The goal was to permit users familiar with time-domain instrumentation to make frequency domain measurements, including vector reflection and transmission coefficients, to 12 GHz and above without having to purchase expensive equipment for the purpose. Engineers and researchers in high-speed digital laboratories supporting activities such as wireless communications often do not have access to frequency-domain network analyzers. A recent "Special Telecom Edition" of Instrumentation Newsletter, which has a worldwide circulation of approximately 65 000, featured the *TDNACal* solution in a cover story.

TDNACal acquires waveforms from the instrument via a standard instrumentation bus (or from a computer file) and fully calibrates the Fourier-transformed data to remove instrument and cable responses from the meas-ured data. The program then displays and saves the device measurements in standard formats. Comparativestudies show results from *TDNACal* agree with state-of-the-art frequency-domain network analyzers to within a few percent to 12 GHz, providing an adequate level of measurement precision for many industrial applications. NIST now offers *TDNACal* on both the MacOS™ and Windows95™ computer platforms and plans further
improvements to meet the needs of industrial users.

CONTACT: Robert M. Judish, (303) 497-3380; robert.judish@nist.gov.

NIST STUDIES IMPACTS OF RESIDENTIAL MECHANICAL VENTILATION APPROACHES

Mechanical ventilation systems for residential buildings can reduce pollutant levels from 20 % to 40 % but unfortunately, according to a completed study done by NIST for the Electric Power Research Institute, also can double the energy consumption. Based on concerns about indoor air quality and trends toward tighter envelope construction, there has been increasing interest in the value of mechanical ventilation in residential buildings. NIST analyzed a fictitious two-story house in Spokane, WA, using the multizone airflow and contaminant dispersal model CONTAM. One-year simulations were performed for four different ventilation approaches: a base case of envelope infiltration only, passive inlet vents in combination with exhaust fan operation, an outdoor intake duct connected to the forced-air system return balanced by exhaust fan operation, and a continuously operated exhaust fan. This work showed that envelope leakage, even in a relatively tight house, results in overventilation (relative to the residential ventilation requirement in ASHRAE Standard 62-1989) during severe weather. However, the same house can be underventilated during mild weather conditions. Incorporating a mechanical ventilation system increases the air change rate during mild weather, thereby reducing contaminant concentrations and occupant exposure. The negative energy impacts found can be reduced through a combination of tighter building envelopes, reductions in air distribution duct leakage, and the use of efficient fans in the ventilation systems. The results are described in detail in the final report (NISTIR 6162).

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METHOD DEVELOPED FOR SIMULATING THERMAL MAGNETIZATION DECAY TO TEST SUITABILITY OF MATERIALS FOR MAGNETIC RECORDING MEDIA REVEALS ERRORS IN CONVENTIONAL MEASUREMENTS

Two NIST scienctists have developed a new method that provides more accurate estimates of the suitability of a material for use as a magnetic recording medium. Writing a bit constitutes a transition in which the magnetic direction is reversed for the area of the bit. Concerns include how fast a magnetized bit may be written and how well a material preserves a bit after it has been written in the presence of demagnetizing fields, for example from adjacent bits. How firmly the magnetic orientation "sticks" is sometimes referred to as "magnetic viscosity." Thermal decay mechanisms affect this parameter. In the conventional method, a vibrating sample magnetometer is used to make measurements with a constant demagnetizing field applied to a large sheet of the candidate material which has been magnetized previously in the area over which the measurements are made.

The scientists have simulated the observed thermal magnetization decay that occurs in bit transitions by arranging for the applied field to decay logarithmically at a rate consistent with the observed decay. The magnetic decay measured using this technique is logarithmic in time but is almost a factor of four smaller than that meas-ured using a constant applied field. These results imply that the standard viscosity measurement is inappropriate when estimating the amount of thermal broadening due to demagnetizing field within a transition. The measurements are important for gauging what is known as the superparamagnetic limit to recording density for magnetic media, a serious concern for the magnetic data storage industry. The NIST measurements indicate that the potential problem may not be as severe as previously indicated by conventional measurements.

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FIRST SPUTTER DEPOSITION SINGLE-CRYSTAL NICKEL FILMS GROWN ON ORIENTED DIAMOND SURFACES

NIST researchers participating in the National Storage Industry Consortium (NSIC)'s magnetic thin film characterization round robin have succeeded in growing a series of single-crystal nickel films on (100) oriented diamond surfaces. The intent is to investigate films that may serve as reference artifacts for calibrating instrumentation used in the magnetic recording industry. NIST researchers have produced a series of films from 10 to 140 monolayers thick. These samples, unique in part because they were the first created using a sputter deposition technique, are coated with protective layers of tantalum and carbon. A small lattice mismatch between nickel and diamond (≈1 %) results in the growth of low-strain films with high remnant magnetization.

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PROGRAMMABLE JOSEPHSON VOLTAGE STANDARD SYSTEM ENHANCES WATT-BALANCE EXPERIMENT

A new programmable Josephson voltage standard (PJVS) system based on superconductor-normal-superconductor (SNS) junctions has been developed by NIST scientists and it's many advantages demonstrated in the NIST watt-ballance experiment. The latter is under active development to provide an electronically derived kilogram. The PJVS system is ultrastable, noise resistant, and can be programmed rapidly to any voltage in the range +1.1 V to –1.1 V. The Josephson circuit is a segmented array of 32 768 SNS junctions. Application of computer-controlled bias currents on 13 input lines allows digital control of the output voltage. These characteristics are an excellent match for the voltage reference needs of the watt-balance experiment. The stability and noise immunity of the new PJVS system allow a direct connection to the experiment. This connection eliminates the intermediate steps previously required to protect a conventional Josephson standard from noise pick up from the experiment. In a preliminary trial, the new standard worked correctly for both force and velocity modes. Work is under way to optimize the controlling electronics into a convenient and reliable instrument that can be incorporated permanently into the watt-balance. This new voltage reference should reduce significantly the uncertainties associated with voltage measurements required in the experiment.

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NIST KICKS-OFF ELECTRONIC COMMERCE TESTBED FOR ELECTRONICS MANUFACTURING

A NIST team of scientists is working with industry to address the challenge of communicating information via the Internet to the members of a distributed supply chain. In contrast to the plug-and-play factory project of the National Electronics Manufacturing Initiative,

focused on the assembly of printed-wiring boards, the NIST Internet Commerce for Manufacturing (ICM) project is intended to apply to the entire manufacturing supply chain. A component of the National Advanced Manufacturing Testbed program, the ICM project is drawing on the skills of many NIST staff.

The problem being addressed is that while high-cost state-of-the-art equipment can place components on a printed-wiring board at speeds of 32 000 components a minute, the manufacturing and assembly process grinds to a halt when complex information must be shared and interpreted across a distributed supply chain. Typically, an original equipment manufacturer (OEM) will contract out the production of a board design to an electronics manufacturing services (EMS) provider, who, in turn, will contract out circuit board, test equipment, and silk screen fabrication. An EMS also may have to purchase thousands of electronic and mechanical components from hundreds of suppliers. Each partner in the production process must be sure they are working from the correct version of the product design and that their software tools are consistently interpreting the information received. This task is particularly challenging since the design usually lacks manufacturing details, is often not transmitted electronically, and when electronic, is commonly in an outdated, difficult-to-use format. The ICM testbed will provide a venue for demonstrating and evaluating the concept of transferring design and manufacturing information via the Internet and of the steps needed to integrate business and technical data for this purpose. The initial test vehicle will be a board design from NIST. Software applications running on a geographically distributed collection of workstations, to-gether with state-of-the-art surface-mount manufacturing equipment at Georgia Tech, form the testbed, a dynamic entity.

To date the ICM project has held two industry workshops and conducted one site visit to develop project requirements. The workshops drew participation from OEMs, EMS providers, board fabricators, software solutions providers, universities, and standards consortia. The ICM team was invited to tour the facilities of a local EMS provider, who walked the NIST group through the steps in production and information exchange processes. Currently under way are a business-case analysis (with the assistance of an outside consultant) and an activity model, which captures all of the process steps and dependencies involved in the manufacture of printed-wiring boards. The project also is participating in the development of a standard for the CAD-to-CAM transfer of board design information.

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MONTE CARLO CALCULATIONS SUCCESSFULLY PREDICTED FERROELECTRIC BEHAVIOR

Ferroelectric materials such as PMN ($Pb_3MgNb_2O_9$) are used widely to fabricate multilayer capacitors and transducers. Related materials include BZT ($Ba_3ZnTa_2O_9$), which is used in high-performance dielectric resonators for wireless communications. The electronic properties of these materials are strongly dependent on the exact ordering patterns adopted by the atoms within the ceramic material; only certain, precise arrangements result in electronically useful properties. Improved understanding of why and how these particular arrangements occur is needed by industry to improve processing control and reduce the associated costs.

Recently, researchers at NIST have made significant advances in the development of computational tools to model the structural behavior of these important materials. Initially thought to be an intractable problem, Ising model Monte Carlo calculations have demonstrated that it is possible to use very simple models with only three or four variables to simulate atomic ordering phenomena in these materials as a function of temperature. This approach has been used to predict a series of ordering patterns in both PMN and BZT; the known behavior of these materials has been reproduced, and new ordering patterns have been predicted. Experimental studies to confirm the existence of the predicted phases are in progress. This computational approach will be extended to predict the structural behavior of other related compounds with technically useful dielectric and ferroelectric properties.

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MAGNETIC BEHAVIOR OF ELECTRODEPOSITED Cu-Co MULTILAYERS

A collaborative project between the University of Maryland and NIST has generated new insight into the evolution of the magnetic properties of electrochemically prepared Cu/Co multilayers. These materials exhibit the giant magnetoresistance (GMR) effect and are being investigated for their potential use as magnetic field sensors. A wide range of substrates, ranging from Cu single crystals to semiconductors, has been examined. Recently, several multilayers were produced containing Cu layers 17 monolayers thick and Co ranging in thickness from 0.5 to 10 monolayers. The films were grown by electrodeposition onto highly textured, 40 nm thick Cu seed-layers on the (100) crystallographic planes of Si. An examination of the magnetization revealed two transitions associated with increasing

thickness of the cobalt layers. A shift from superparamagnetic to ferromagnetic behavior occurs after deposition of >2.1 monolayers while a transition from isotropic, in-plane magnetization to fourfold anisotropic behavior occurred between 3.4 monolayers and 4.5 monolayers. Analysis of current transients associated with heteroepitaxial deposition of Co and Cu (100) indicated that the onset of the fourfold magnetocrystalline anisotropy occurs when the deposition current reached a steady-state value, which usually is ascribed to coalescence of the ultra-thin cobalt layers. Other studies also have been initiated to examine the magnetic properties of Cu/Co multilayers electrodeposition directly on silicon. This simple process has generated polycrystalline Cu/Co laminated films that exhibit up to 6 % GMR. Further work is in progress.

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NIST SUPPORTS DEVELOPMENT OF A NEW TYPE OF HEARING AID

To support development of a new type of hearing aid, NIST recently completed an extensive series of measurements that will assist designers in improving the speech intelligibility of hearing aids. The measurements were made in the NIST large anechoic chamber on the prototype of a new microphone array design intended for use as a hearing aid. A private company developed this array under a Phase 2 Small Business Initiative Research (SBIR) grant from the National Institutes of Health. The company has prior experience in designing directional arrays for underwater sound (passive sonar) applications as well as with directional microphone arrays for use in air. Hybrid adaptive beam-forming techniques, based on algorithms implemented in a user-worn battery-operated digital signal processing pack, are used to achieve directional characteristics intended to separate a speech signal ("target" signal produced by a talker whose speech is the intended target of reception by the listener) from unwanted, interfering sounds. Hearing aids usually amplify all sounds, including background conversations and noises.

The microphone array was placed on a manikin in the anechoic chamber and sets of intermicrophone transfer functions were obtained using a multichannel measurement system. The directional characteristics of each individual microphone element were measured, as were directional properties of the processed output of the array. Responses of the array elements to several inputs were recorded. These included broadband sound signals from the target source at several positions, speech signals from the target source at several positions, "babble" signals from several positions, and simultaneously presented pairs of target source speech and "babble" signals from various positions.

This extensive data set now can be used by the designers to test the relative effectiveness of numerous different software signal processing algorithms on characteristics such as speech intelligibility and listener aversion to processing distortions without having to perform additional recordings for each in the anechoic chamber.

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POLARIZING NEUTRONS WITH POLARIZED ^{3}He

NIST researchers at NIST recently made great strides in developing neutron polarizers and analyzers based on ^{3}He gas with polarized nuclei. The cross section for absorption of neutrons by ^{3}He nuclei depends strongly on the relative polarization of the nuclei and the incident neutrons. When a beam of randomly polarized neutrons passes into the polarized ^{3}He gas, one of the two neutron polarization states is highly absorbed by the ^{3}He nuclei while the other neutron polarization state passes through with much less attenuation, leaving a neutron beam with polarization purity that can approach 90 %. Polarized neutrons have numerous applications in materials science and fundamental physics research.

Although several different technologies exist for polarizing neutrons in restricted energy ranges and with other constraints, polarized ^{3}He can be used for highly versatile neutron polarizers with unique capabilities. Polarized ^{3}He gas can be produced by two different optical pumping techniques, known as spin-exchange and metastability-exchange. NIST is unique among the few institutions in the world studying polarized ^{3}He in that both methods are being pursued concurrently. The two methods have different advantages optimal for different applications.

The key technical hurdle in making the neutron polarizers is producing highly polarized ^{3}He gas. But another challenge is developing glass cells to hold the polarized gas that do not strongly attenuate the neutrons. Neutrons are strongly absorbed by ^{10}B, a common component of most glasses. The NIST scientists pioneered the use of ^{10}B-depleted aluminosilicate glass for the polarizer cells and is investigating reforming of a boron-free glass.

Because the absorption cross section varies with neutron wavelength, a monochromatic beam is ideal for testing ^{3}He-based neutron polarizers. The NIST scientists recently completed a monochromatic cold neutron beamline at the NIST Center for Neutron Research and has been using the beamline to test neutron polarizers based on each optical pumping method. A new cell

made from boron-depleted glass has yielded the best NIST spin-exchange results to date: 88 % neutron polarization with 8 % transmission. In the same experimental run, a polarizer based on the metastable method yielded 67 % neutron polarization with 18 % transmission. The ^{3}He nuclear polarization for both tests was 45 %. The difference in neutron polarizations is related to the "thickness" of the polarizer and illustrates the trade-off of polarization and transmission typical for this type of polarizer.

This experiment marked the first use of the metastable method for a neutron polarizer in the United States and was made possible because of a polarized gas compression apparatus recently developed at NIST. Goals for the future include demonstration experiments for applications and further improvement of the polarizers themselves.

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NEW TECHNIQUE FOR DETECTING CHEMICAL WEAPONS

Researchers at NIST are using high-resolution Fourier-transform microwave (FTMW) spectroscopy to unambiguously identify trace amounts of deadly Sarin nerve gas and related chemical warfare agents in air samples. The technique developed by two NIST scientists, should be crucial in verifying weapons treaty compliance and in monitoring for terrorist activities. Sarin and related nerve gases are among the deadliest substances known, with lethal doses as small as 1 mg.

Nerve gases such as Sarin can in principle be identified through infrared and mass spectral analysis; however, those techniques give signatures of portions of the molecule under study. Broad spectral studies are necessary to distinguish Sarin (for example) from other common substances sharing similar molecular structure. In contrast, the microwave spectrum reveals rotational transitions unique to the individual molecule, with observation of a single absorption line unambiguously identifying the chemical. This specificity is important, because chemical weapons treaties permit only limited testing to prevent revealing too much national security information.

The NIST scientists working with the Army's Edgewood Research, Development, and Engineering Center (ERDEC), obtained FTMW spectra of Sarin samples with a high spectral resolution. They compared the measured spectra with those they calculated from the Sarin structure and found essentially perfect agreement. They identified numerous spectral lines in the 12 GHz to 14 GHz range that can be used for Sarin fingerprinting. This technique appears to be more than adequate for treaty verification through inspection of air samples from suspected chemical agent production or storage facilities.

The NIST scientists plan to verify that the method works well for a variety of chemical agents and their precursors and byproducts. They also plan to develop a database of microwave transitions for the agents and their byproducts as well as standards and calibrations for detection, useful in monitoring military or terrorist nerve gas production and exposure. The NIST researchers conduct direct work with the nerve agents at ERDEC laboratories at the Aberdeen Proving Grounds, which have special facilities to safely handle the deadly chemicals.

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SCIENTIFIC APPLICATIONS SUPPORT PROJECT RELEASES "AUTOMAP ON THE WEB"

AutoMap is a program designed to create Message Passing Interface (MPI) data-types automatically from C language data-types. Users run their code through AutoMap, and the program figures out the correct memory mapping needed, creates the requisite C language code to implement the mapping, and names the MPI data types after the users given C language data-types. This is now web accessible allowing anyone to use this tool through the AutoMap Web page. This page is located at http://www.nist.gov/itl/div895/auto/.

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ENERGY-RELATED INVENTIONS PROGRAM MAKES RECOMMENDATIONS

During the month of April the NIST Office of Technology Innovation recommended three innovative technologies for commercialization to its Department of Energy partner under the Energy-Related Inventions Program.

- High Throughput Manufacturing of High Efficiency Solar Cells—a continuous vacuum process designed to replace conventional vacuum batch processes for manufacturing high efficiency CdTe solar cells for generating electricity.
- Novel Method and Apparatus for Ejecting Particulates from the Primary High Temperature Inlet FlowPath of a Coal Fired Turbine Generator—a device for removing, by centrifugal force, solid

particulate matter from the high-temperature exit stream of a coal gasifier.

- The Road Patcher—an assembly of hydraulic components designed to be installed easily on a conventional dump truck.

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DIRECT OBSERVATION OF IN SITU REACTION PROCESSES USING SYNCHROTRON RADIATION

Scientists from NIST, together with researchers from a private company and the University of Michigan, are using near-edge x-ray-absorption fine structure (NEXAFS) measurements to probe the concentration and bonding of adsorbed reactants on model catalyst surfaces. The measurements have yielded an in situ chemical picture of supported catalysts, thereby elucidating reaction processes on complex catalytic surfaces and providing a rational basis for catalyst optimization.

The development of an economically viable direct oxidation process to convert propylene, a gaseous organic hydrocarbon, to propylene oxide (PO) is of great importance to U.S. industry. PO, along with its derivatives, forms a major family of chemicals that are used in products such as urethane foams, coatings, sealants, and adhesives. The current value of products manufactured using PO derivatives is estimated at over $10 billion.

An important step toward developing a molecular level understanding of propylene oxidation would be the identification of previously unknown rehybridized propylene intermediates, but these have never before been seen. In this research, room-temperature propylene adsorption and nearly complete rehybridization were used for the first time to form a reaction intermediate on dispersed silver, supported on TiO_2 (anatase). NEXAFS spectra of the reaction intermediate reveal the nearly complete extinction of the carbon double bond pi* resonance in propylene upon chemisorption onto dispersed silver supported on TiO_2 (anatase). The silver loading and the dispersion on the support dramatically affect the observation. The rehybridization of propylene at room temperature indicates that support/metal interactions likely play an important role in the reaction since no propylene adsorption is seen on the neat support material, and propylene does not adsorb on bulk silver at room temperature.

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NIST ASSISTS DEVELOPMENT OF FIRE INVESTIGATION EDUCATIONAL TOOL

NIST provided technical assistance in the form of a demonstration fire for the development of an educational interactive CD-ROM for fire investigators. The interactive CD, a state-of-the-art educational tool incorporating three-dimensional fire scene manipulation, is being developed by a Federal Government and industry partnership consisting of the Bureau of Alcohol, Tobacco, and Firearms; the United States Fire Administration; NIST; and a private company. Prior to a demonstration fire experiment, NIST provided input into the choice of furnishings, fire scenarios, and ventilation conditions necessary for the desired fire environment. During the fire experiment, conducted at the Massachusetts State Police Academy in New Braintree, MA, NIST provided measurements of temperature and radiant heat flux as well as video inside the structure.

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NIST HELPS TO FORM ZEOLITE STUDY ASSOCIATION

The importance of zeolites is increasing significantly. These porous crystalline inorganic materials are used for a variety of industrial purposes from cracking of crude oil into gasoline to the synthesis of pharmaceuticals. Zeolites also are used industrially to separate air into oxygen and nitrogen, are used for environmental remediation, and are even formulated in detergents for water softening. Recognizing this importance, a NIST scientist at the NIST Center for Neutron Research (neutron methods are critical tools in zeolite research), along with scientists from SUNY Stony Brook, the University of Pennsylvania, and a private company helped to organize the Northeast Corridor Zeolite Association (NECZA). The first meeting of NECZA attracted over 80 attendees of which approximately 20 were industrial scientists from at least eight different companies. The conference also attracted a number of experts in the field who have retired from industrial positions. Short presentations were followed by moderated discussions to facilitate formal discussion; poster sessions served as a focal point for informal discussions. The meeting was very well received and launched several collaborations. A committee was formed to organize NECZA II for the coming winter.

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NIST COLLABORATING WITH NAVY AND INDUSTRY ON PRODUCIBILITY HANDBOOK

Two NIST scientists are working with the U.S. Navy Best Manufacturing Practices (BMP) Program Office and representatives of U.S. industry to develop a handbook for implementing manufacturing producibility programs. A meeting of the team was held at a private company in Cincinnati, OH, recently, to review and complete the first full draft of the handbook. Participants in this meeting included representatives from private industry, the University of Maryland, the University of Texas at Austin, the Navy BMP Center of Excellence, and NIST. The handbook describes the steps necessary to implement a manufacturing producibility program in both large and small manufacturing companies. The document contains a comprehensive list of software tools, a bibliography, case studies, and a glossary of terms. The target publication date for the handbook is December 1998.

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NIST ASSISTS FEDERAL AGENCIES WITH GUIDANCE ON SECURITY TRAINING

NIST has issued a new special publication on information technology security training. Special Publication (SP) 800-16, Information Technology Security Training Requirements: A Role-and Performance-Based Model, was written by the Federal Computer Security Program Managers Forum and the Federal Information Systems Security Educator's Association (FISSEA).

SP 800-16 is the second NIST special publication on security training and was written in response to several Federal requirements. The Computer Security Act of 1987 (Public Law 100-235) established requirements for "the mandatory periodic training in computer security awareness and accepted computer practices of all employees who are involved with the management, use, or operation of each Federal computer system within or under the supervision of that agency."

To implement this provision of the Computer Security Act, NIST worked with the U.S. Office of Personnel Management (OPM) to develop the first training guidelines, which were issued in November 1989 (NIST Special Publication 500-172, Computer Security Training Guidelines). In January 1992, OPM revised the federal personnel regulations to mandate that agencies provide security training. In 5 CFR Part 930, Employees Responsible for the Management or Use of Federal Computer Systems, agencies are directed to provide mandatory training for current and new employees as well as whenever there is a significant change in an agency's Information Technology (IT) security environment or procedures, or when an employee enters a new position that involves sensitive information. Office of Management and Budget (OMB) Circular A-130, "Management of Federal Information Resources," Appendix III, "Security of Federal Automated Information Resources," reinforces these agency responsibilities for providing mandatory training, including specialized training based on staff members' IT security responsibilities.

Special Publication (SP) 500-172 provided a framework for determining the training needs of particular categories of employees (including contractors) involved with sensitive but unclassified computer systems, but it was oriented to the mainframe environment of its time. SP 800-16 supersedes SP 500-172 and provides a new, conceptual framework for IT security training that is appropriate to today's distributed computing environment. It is expected that the framework will be extended in the future to accommodate changing technologies and their related risk management decisions.

The guideline will be available in paper copy from the Government Printing Office and in electronic format from http://csrc.nist.gov.

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NIST RESEARCH REPORTED AT AMERICAN PHYSICAL SOCIETY MARCH MEETING

At the American Physical Society annual March meeting, NIST scientists reported the development of a new instrument that permits visualization of polymer blends during extrusion. Many plastics sold today are combinations of two or more incompatible polymers. Mixing these components to obtain the proper morphology is key to producing materials with desired properties. The instrument consists of a stroboscopic microscope and laser-based light scattering system that performs real time noninvasive microstructural measurements in multi-phase polymeric materials during polymer processing. The surprising discovery made with this device was that above a threshold shear rate polymer droplets in an incompatible polymer matrix can change their morphology from alignment along the flow direction to alignment perpendicular to it. The ability to access the high stress and pressure regimes typical of polymer processing was critical in uncovering this phenomenon. Such studies can help industry understand what morphology is formed during processing, why it is formed, and how it can be controlled—information that can have a direct impact on the next generation of improved processes and materials.

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NIST CALIBRATES NEW SYSTEM TO IMAGE RADIOACTIVE CONTAMINATION

Scientists at NIST developed the calibration system for a new commercial system that simultaneously images visible light and gamma rays, a highly useful tool in detecting and cleaning up radio-active contamination. GammaCam™ is a portable camera that superimposes images of radioactive hot spots on conventional video images. It was developed by two private companies and the New York State utility. GammaCam's ability to "see" the location and intensity of radioactive contamination in real time greatly simplifies containment and clean-up in high radiation environments.

The GammaCam was developed with support from DoD's Technology Reinvestment Program and uses a high-density terbium-activated scintillating glass detector. Prototypes of GammaCam's detector were calibrated in NIST's cesium-137 standard gamma-ray ranges. The primary gamma ray from ^{137}Cs decay has an energy of 662 keV, near the middle of the energy range for mixed fission products normally found at radioactive contaminated sites. NIST provided GammaCam's developers with sources having a dose-rate range of four orders of magnitude.

GammaCam was originally designed for imaging in decontamination operations in commercial nuclear power reactors. DoE subsequently has used the camera for imaging several contaminated areas in former Soviet nuclear naval facilities in Estonia. Present applications of GammaCam include environmental restoration surveys, hospital radiation control, and nuclear materials control.

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NIST SOLVES MEASUREMENT DISCREPANCY FOR RADIOPHARMACEUTICAL

Scientists at NIST recently discovered large errors in commercial equipment used to calibrate doses of the important experimental radionuclide rhenium-188. The investigative use of ^{188}Re in nuclear medicine is widespread and rapidly growing. Applications being studied include: relief of cancer-caused bone pain; radioimmunotherapy (attaching radionuclides to antibodies to target specific tissues); relief of arthritis and other joint problems; and intra-vascular brachytherapy to prevent spontaneous reclosing of coronary arteries following balloon angioplasty (a frequent occurrence). Clinical trials and research to determine safe and effective uses of ^{188}Re have been hampered by poor dose metrology.

Radioassays of ^{188}Re normally are performed in clinics and hospitals using re-entrant well ionization chambers ("dose calibrators") that require a variable calibration factor (dial setting) specified by the manufacturer. Accurate clinical or research measurements of the radionuclide, therefore, depend on this calibration factor. However, NIST scientists recently discovered that the manufacturer-recommended calibration factor for the world's most widely used dose calibrator overestimates the actual radioactivity by about 28 %.

NIST scientists accurately measured 1^{88R}Re in various samples using liquid scintillation counting and counting in the NIST ionization chamber, determining new calibration factors for ^{188}Re in both a 5 mL dose vial (containing nominally 2.5 mL of ^{188}Re solution) and the standard NIST-style ampoule (containing 5 mL of ^{188}Rh solution). The results were confirmed independently by collaborators at Cedars-Sinai Medical Center (Los Angeles) using a NIST-calibrated source. The new instrument calibration factors will permit researchers and clinicians to measure ^{188}Re radioactivity with a relative uncertainty of less than 1 %, improving clinical trial results and patient safety. The details of this study are being prepared for publication in the Journal of Nuclear Medicine.

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NIST FINDS THAT FLAMMABLE REFRIGERANTS MAY BE THE ANSWER

Researchers at NIST have completed an experimental investigation of a laboratory heat pump and found that with proper design of equipment components selected flammable refrigerants can be as much as 8 % more efficient than R22, the conventional refrigerant for heat pumps. The refrigeration industry already has selected replacements for R22 since it is being phased out early in the next century due to ozone depletion in the stratosphere. The replacements themselves, however, are now being re-evaluated due to concerns about global warming. Some flammable refrigerants would be ideal replacements because of their short atmospheric lives and low global warming potentials but have received limited attention because of liability concerns for refrigerant piping passing through the inhabited space. The current research also has demonstrated how the heat pump could be designed with the flammable refrigerants isolated outside the building.

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NIST ANNOUNCES WEBMETRICS 1.0

NIST's WebMetrics Tool Suite contains rapid, remote, and automated tools to help in producing usable web sites. The free software is available at http://www.nist.gov/webmetrics.

The Web Static Analyzer Tool (WebSAT) checks the html of a web page against numerous usability guidelines. The output from WebSAT identifies potential usability problems that should be investigated further through user testing. WebSAT can be executed from any web browser or downloaded to accommodate those behind firewalls.

The Web Category Analysis Tool (WebCAT) lets the usability engineer quickly construct and conduct a simple category analysis across the Web. WebCAT should be downloaded and installed on the local Web server to allow local storage of the result files. Examples of the use of the WebCAT tool are available on the Web site.

The Web Visual Instrumenter Program (WebVIP) lets the usability engineer rapidly instrument a web site for local or remote testing by employing visual instrumenting as well as automated techniques. WebVIP must be downloaded and installed on the local web server before it can be run.

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MOLECULAR-LEVEL DETAILS OF A SELF-ASSEMBLY PROCESS

NIST scientists have used an ultrasensitive optical technique and a combination of synthetic and natural biological molecules to probe the mechanism of self-assembly of biological membranes. The optical technique is surface plasmon resonance, which, in the absence of any secondary labels, can directly detect the addition of femtomoles of small molecules to a metal surface. In biology, complex structures, such as cell membranes, self-assemble from many lipid and protein components.

To understand these structures better, a novel biomimetic membrane—a model of a cell membrane—is assembled from alkanethiols and phospholipids. Surface plasmon resonance was used to measure the kinetics of the self-assembly of a single molecular layer of phospholipids onto a layer of alkanethiols on a gold surface to form a bilayer. The reaction starts when a solution of liposomes, multimolecular assemblies of thousands of phospholipid molecules, is added to a receptacle containing the gold-supported alkanethiol layer. Hydrophobic interactions between the alkanethiols and the phospholipids are ultimately responsible for their association into a bilayer, but does this bilayer form from one phospholipid molecule at a time, or is bilayer formation the result of liposomes supplying thousands of phospholipid molecules to the surface simultaneously? Kinetic analysis of this reaction determined for the first time that the bilayer is formed by the diffusion of liposomes to the surface and not by diffusion of individual lipid molecules. This result has profound implications for predicting the composition of such biomimetic membranes and will facilitate the fabrication of biologically relevant surfaces for the study of pharmaceutical activity, redox enzymes, and functional biosensors.

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X-RAY CRYSTAL STRUCTURE OF BIOTECHNOLOGY ENZYME

The rapidly expanding biotechnology industry depends on detailed structural data derived from x-ray diffraction measurements of protein crystals. Both how these crystals grow and how to extract structural data from them are, therefore, areas of research and development worldwide. NIST scientists have applied these techniques to elucidate the three-dimensional structure of the enzyme threonine deaminase from E. coli. This enzyme is of particular interest because it catalyzes a key reaction in a pathway that is being engineered to produce biodegradable plastics in plants. It is also one of only a few allosteric enzymes to have their structures determined, and allostery may provide a means for regulating its activity.

The enzyme is a tetramer made of 2056 amino acid residues in four polypeptide chains, with four vitamin B6 cofactors located in the active sites. Its large size made the measurements and calculations challenging, and a new computational method was developed to focus the electron density maps and interpret the structure. In addition to its potential application in producing environmentally benign plastics, the enzyme belongs to a pathway operative in plants and bacteria but completely absent in animals, and, therefore, its specific inhibition could provide a strategy for controlling weeds or combating bacterial disease.

CONTACT: Travis Gallagher, (301) 975-5726; travis.gallagher@nist.gov or Edward Eisenstein, 738-6244.

AN ISO SUCCESS STORY

NIST response to an industry requirement for a particular sensor calibration led to development of an ASTM (American Society for Testing and Materials) Standard Method and recently to an ISO International Standard. Technology was developed for acoustic emission

sensor calibration, where the challenge is fidelity detection of high-frequency elastic wave motion of very short duration (typically microseconds) and very small displacement amplitude (nanometers or less). Further, these dynamic wave pulses must be detected as they travel past the sensor at the speed of sound.

The original work for this calibration methodology was based on fundamental pulsed wave propagation studies performed by NIST scientists in the 1970s. A 1982 publication entitled Acoustic Emission Transducer Calibration by Means of the Seismic Surface Pulse based on their work laid the foundation for the calibration methodology requested by and partially funded by industry. Subsequent activity under the leadership of a NIST scientist resulted in the rapid adoption by ASTM in 1986 of a Standard Method for Primary Calibration of Acoustic Emission Sensors. The process for the development of an ISO standard was begun in the early 1990s and recently was completed by a 100 % approval vote of a Final Draft International Standard document entitled "Non-destructive testing—Acoustic emission inspection—Primary calibration of transducers." It now is awaiting formal publication as an ISO International Standard.

Contact: Gerry Blessing, (301) 975-6627; gerry.blessing@nist.gov.

ULTRAFAST TRUE TEMPERATURE MEASUREMENTS FOR THERMOPHYSICAL PROPERTIES

Microsecond pulse-heating techniques in which a large electric current is passed through a specimen, such as a wire, are being used at NIST for measurement of thermophysical properties in the temperature range 1500 K to 5000 K. The currents are generated by a capacitor discharge system and are capable of heating samples at rates up to 10^8 K/s. If proper care is taken, the material heats up to temperatures far in excess of its melting point, and the liquid cylinder formed by the melted wire does not collapse until about 30 μm after melting. During this time, precision optical pyrometry, voltage, and current measurements allow determination of specific heat capacity, heat of fusion, and electrical resistance of the molten metal or alloy as a function of radiance temperature. Measurements at these temperatures are not feasible by other means.

To convert the sample's measured radiance temperature to a true temperature as the sample is heated, its emissivity must be known. All prior data using microsecond pulse heating both at NIST and elsewhere have been subject to temperature measurement errors arising from uncertainty in the emissivity. To solve this problem, NIST recently collaborated with a private company to develop and install on the NIST apparatus an ultrahigh speed laser polarimeter system. Measurements of the polarization of laser light reflected from the specimen allow emissivity to be determined on a microsecond time scale simultaneously with the pyrometric measurements.

This new ultrahigh speed capability will provide critical thermophysical information needed for practical applications by the casting industry as well as benchmark scientific data. The technique allows the first rapid accurate measurements of liquid properties as a function of true temperature in a range extending hundreds of degrees above the melting point. Moreover, it provides a significant advance in the field of ultrafast true temperature measurement.

CONTACT: John R. Manning, (301) 975-6157; john.manning@nist.gov.

NIST'S ASYNCHRONOUS TRANSFER MODE (ATM) SIMULATOR WIDELY USED FOR ATM PERFORMANCE ANALYSIS

NIST's ATM simulator continues to have a major impact on industry and the research community as an effective tool for ATM analysis. In April 1998 NIST started to track requests for the ATM simulator to assess its continuing value to industry and the research community. During the first 6 weeks of monitoring, more than 500 copies of the software were downloaded. About a dozen major U.S. companies and four government laboratories retrieved copies of the software. The majority of the copies were retrieved by university students doing network research.

In 1994, a NIST scientist developed the ATM simulator software to analyze the performance of various ATM protocols without the expense of building a real network. Ongoing improvements to the tool continue to increase its effectiveness. For more than 4 years, this technical and specialized product has been available for download through the Internet at http://www.hsnt.nist.gov/misc/hsnt/prj_atm-sim.html.

NIST actively participates in the development of protocols and test suites through the ATM Forum, an industry group that develops specifications for ATM cell switched networks.

CONTACT: Nada Golmie, (301) 975-4190; nada.golmie@nist.gov.

TRANSATLANTIC INITIATIVE PROVIDES FORUM FOR INTERNATIONAL MANUFACTURING ALLIANCES

The Manufacturing Extension Partnership (MEP) in Illinois, known locally as the Chicago Manufacturing Center (CMC) and The Executives Club of Chicago, in cooperation with the European Commission (EU) and Eurochambers, are hosting a matchmaking event to promote business-to-business partnerships between small and mid-sized manufacturers from the Midwest and European Union countries. The conference represents the first effort of the Transatlantic Small Business Initiative, a joint EU-U.S. venture to reduce barriers to the movement of goods, services and capital. CMC has produced a conference catalogue profiling more than 400 U.S. companies at no cost to qualified firms. This catalogue will be distributed throughout the EU and provide a description of each company, its products, and specific interest in seeking an international partner. In addition, companies wishing to be profiled, seeking to register for the conference, and/or review existing profiles of companies can do so on-line at the matchmaking web site (http://www.TABD-SME.com) created and maintained by CMC.

CONTACT: Sherri Burns, (301) 975-5031; sherri.burns@nist.gov.

LIGHTING CONSORTIUM MEETS AT NIST

NIST hosted a program review of the ALITE lighting research consortium in June 1998. The ALITE Consortium, organized by the Electric Power Research Institute (EPRI), brings together scientists and engineers from NIST, private industry, the University of Wisconsin, and Brooklyn Polytechnic Institute to conduct basic research that may lead to breakthrough improvements in commercial lighting efficiency. Lighting consumes about 40 % of U.S. total commercial electrical power, and the ALITE Consortium is striving to double lighting efficiency through improved understanding of electrical discharge processes used in most commercial lighting. The program review helped ALITE members define complementary research programs covering a broad range of atomic processes in lighting discharges. Future semiannual program reviews are planned.

CONTACT: Craig Sansonetti, (301) 975-3223; craig.sansonetti@nist.gov.

NEW REFRIGERANT MEASUREMENT TECHNOLOGY

Researchers at NIST have demonstrated that it is feasible to use the fluorescence from a boiling heat transfer surface to determine the concentration of lubricant in a lubricant/refrigerant mixture. The heat transfer performance of a boiling surface in refrigeration equipment is a strong function of both the type of lubricant and its concentration in the refrigerant. During the boiling of the refrigerant, excess lubricant resides in a very thin layer on the surface. Severe boiling performance degradation can occur in evaporators for high concentrations of lubricant on the surface. In measurements of ten lubricant samples in special test equipment at NIST, researchers found that lubricant concentration on an aluminum “stepped” target surface was a linear function of fluorescence intensity and the reflected harmonic from the surface. The next step of the research will be to test the concept on an existing pool boiling rig in the Gaithersburg laboratories using a bifurcated optical bundle with both excitation and emissions detection in a single cable.

CONTACT: Mark Kedzierski, (301) 975-5282; mark.kedzierski@nist.gov.

NIST ASSISTS COMPANY IN DEVELOPMENT OF SUPER INSULATION

NIST completed measurements and analysis in a newly created advanced Insulation Testing Laboratory that has enabled a private company to release the most efficient building insulation material on the market today, six times more efficient than glass fiber insulation. NIST’s new laboratory is equipped with a specially designed calorimeter capable of measuring both the heat conducted through the panel as well as barrier materials that are required to guard against edge losses in super insulation. The company’s product consists of a patented, extremely small-cell porous foam material that can be totally evacuated and sealed within a metallized film. Through repeated measurements in the calorimeter, with infrared thermography, and use of thermal analysis software, NIST was able to show the company the effectiveness or lack thereof for candidate barrier designs and enable them to achieve their outstanding results. The product is expected to be used first where space is a premium, as in the walls of refrigerators. The manufacturers can use thinner advanced panels to allow greater interior refrigerator-volume and yet still achieve the stringent energy efficiency standards on the horizon to combat global climate change.

CONTACT: Hunter Fanney, (301) 975-5864; hunter.fanney@nist.gov.

JAVA GRANDE FORUM ESTABLISHED

Two NIST scientists were named co-chairs of the Numerics Working Group of the Java Grande Forum (JGF) at its inaugural meeting in Palo Alto, CA, in

March 1998. The JGF is an open forum of industrial, government, and academic researchers and software developers interested in improving the Java language and environment for use in high-performance computing. The work of the JGF has the support of a private company as part of its open standardization process for Java. The Numerics Working Group is chartered to be the voice of the community on changes to Java, which would make it suitable for numeric-intensive applications as well as a center of coordination for the development of community-supported class libraries and interfaces for core numerical computations. The work of the group is described on the Java Numerics web pages at http://math.nist.gov/javanumerics. The JGF's second working group addresses issues of Parallel and Distributed Computing.

CONTACT: Ron Boisvert, (301) 975-3812; ron.boisvert@nist.gov.

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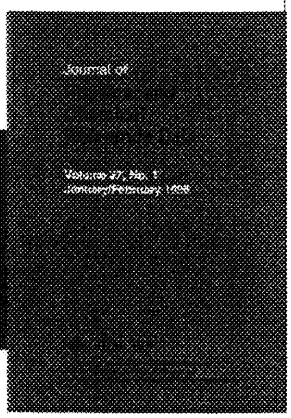

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by Marilyn E. Jacox , Optical Technology Division, National Institute of Standards and Technology, Gaithersburg, MD, U.S.A. *(March/April 1998)*

The Viscosity of Carbon Dioxide
by A. Fenghour (Department of Chemical Engineering and Chemical Technology, Imperial College, London, U.K.), W. A. Wakeham (Department of Chemical Engineering and Chemical Technology, Imperial College, London, U.K.), and V. Vesovic (Department of Earth Resources Engineering, Imperial College, London, U.K.) *(January/February 1998)*

An International Standard Equation of State for Difluoromethane (R-32) for Temperatures from the Triple Point at 136.34 K to 435 K and Pressures up to 70 MPa
by Reiner Tillner-Roth (Institut für Thermodynamik, Universität Hannover, Hannover, Germany) and Akimichi Yokozeki (DuPont Chemicals, Fluorochemicals Laboratory, Wilmington, Delaware, U.S.A.) *(November/December 1997)*

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The International System of Units (SI)
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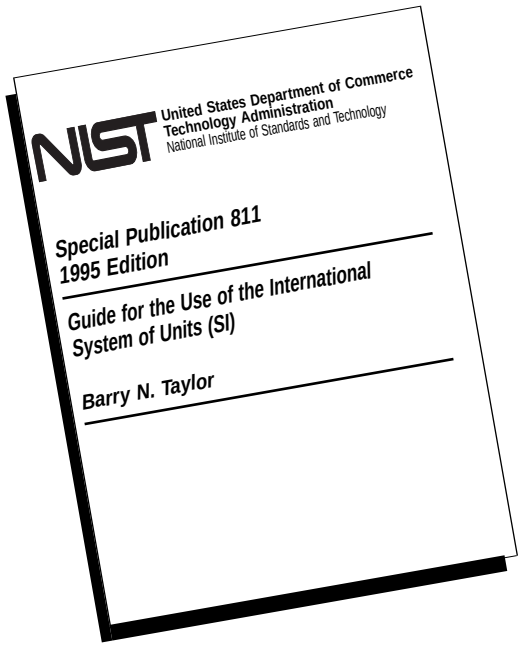

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The 1995 edition of the National Institute of Standards and Technology Special Publication 811, *Guide for the Use of the International System of Units (SI)*, by Barry N. Taylor, is now available.

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

The topics covered by SP 811 include:

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