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# News Briefs

## General Developments

*Inquiries about News Briefs, where no contact person is identified, should be referred to the Managing Editor, Journal of Research, National Institute of Standards and Technology, Building 416, Room 119, Gaithersburg, MD 20899-0001; telephone: 301/975-3572.*

### ATP MAKES 41 AWARDS IN FOUR FOCUSED COMPETITIONS

NIST's Advanced Technology Program has announced the first awards under its "focused program" approach that establishes multiyear R&D programs focusing on particular technology and business goals as identified by the private sector. Forty-one awards totaling approximately $170 million were made for five-year programs in four focused areas: Information Infrastructure for Healthcare, 16 awards ($72 million), Tools for DNA Diagnostics, 13 awards ($56 million), Component-Based Software, 11 awards ($40 million), and Computer-Integrated Manufacturing for Electronics, one award ($1.5 million). The total ATP funds in these competitions will be matched by industry. The ATP provides cost-sharing support to industry to promote promising, but high-risk, enabling technologies that can form the basis for new and improved products, manufacturing processes and services. For a list of the latest awards or fact sheets on the four program areas, fax a request to (301) 926-1630 or send an e-mail message to: baum@micf.nist.gov (via Internet). This information also is available electronically from the NIST gopher (gopher-server.nist.gov) under the "NIST News & General Information" section. For information on the ATP, call (800) ATP-FUND (287-3863) or send e-mail to: atp@micf.nist.gov (via Internet).

### THREE COMPANIES WIN 1994 BALDRIGE AWARD

The 20th, 21st, and 22nd winners of the Malcolm Baldrige National Quality Award were announced by President Clinton on Oct. 18, 1994. The companies are AT&T Consumer Communications Services (Basking Ridge, NJ) and GTE Directories Corp. (Dallas/Fort Worth, TX) in the service category, and Wainwright Industries Inc. (St. Peters, MO) in the small business category. AT&T CCS, the largest of the 20 AT&T units, provides domestic and international long distance communications services for more than 80 million customers—a 60% share of the long distance market. GTE Directories is one of the world's largest telephone directory companies, producing more than 1200 titles in 45 U.S. states and 17 countries. Wainwright is a family-owned manufacturer of stamped and machined products for the automotive, aerospace, home security, and information processing industries. The three winners will be honored for their world-class systems of management, employee involvement and customer satisfaction at a ceremony in Washington, DC, later this year.

### 1995 BALDRIGE CRITERIA RECOMMEND BUILT-IN QUALITY

The criteria for the Malcolm Baldrige National Quality Award have been streamlined and changed for 1995 to focus more sharply on quality as an integral part of today's business management practices. The criteria are designed to help companies deliver ever-improving value to customers and improve a company's overall performance and capabilities. Since the award was established in 1987, almost 1 million copies have been distributed. Thousands of organizations use them as a quality improvement "road map." The 1995 criteria focus on seven key areas of business performance:

customer satisfaction and retention; market share and new market development; product and service quality; financial indicators, productivity, operational effectiveness and responsiveness; human resource performance and development; supplier performance and development; and public responsibility and corporate citizenship. Companies that build the Baldrige criteria into their business practices should see improvements in market share, financial performance, productivity, employee relations and customer satisfaction. Single copies of the 1995 award criteria are available free of charge from NIST by calling (301) 975-2036 or faxing (301) 948-3716. Packets of 10 may be ordered for a fee from the American Society for Quality Control by calling (800) 248-1946.

## DIGITAL SIGNATURE INFRASTRUCTURE TO BE TESTED

To encourage widespread use of digital signatures, NIST is seeking comments on a proposal for a pilot public key infrastructure program necessary for implementing the federal Digital Signature Standard (DSS). A digital signature allows the recipient of an electronic message or file to verify the sender's identity and the integrity of the file. The DSS uses private digital keys, held by the user, and public keys, which must be assigned and certified by a reliable third party. In the future, a "public key infrastructure" will manage the certification of public keys on a large-scale basis. In a continued effort to reassure users of the DSS that it does not infringe other patents, the public key infrastructure contract will contain a clause under which the government assumes liability for any patent infringement resulting from the performance of the contract, including use by private parties when communicating with the U.S. Government.

## WORKSHOP TO HIGHLIGHT SEMICONDUCTOR CHARACTERIZATION

NIST will host the "International Workshop on Semiconductor Characterization: Present Status and Future Needs," from Jan. 30–Feb. 2, 1995, at NIST's Gaithersburg, MD, headquarters. The workshop will bring together industry leaders, scientists, and engineers interested in various aspects of the characterization of semiconductor materials, processes and devices to review the major measurement needs facing the semiconductor industry. Invited speakers and poster presenters will discuss the latest advancements in silicon process development and manufacturing; analytical technology and metrology requirements for geometries under 0.3 μm; starting materials, gate dielectrics and process simulation; interconnects and failure analysis; critical analytical methods; silicon and compounds; in-situ real-time diagnostics, analysis and control; and frontiers in compound semiconductors. Three panel sessions on related issues will be organized by a private company. For registration information, contact Jane Walters, B344 Technology Building, Gaithersburg, MD 20899-0001, (301) 975-2050, fax: (301) 948-4081, e-mail: walters@apollo.eeel.nist.gov (via Internet). The registration deadline is Jan. 16, 1995. For technical information, contact David Seiler, (301) 975-2081.

## NEW CENTER NOW SERVING MASSACHUSETTS COMPANIES

The U.S. Department of Commerce and the Commonwealth of Massachusetts signed a letter of partnership on Nov. 4, 1994, that officially launched the Massachusetts Manufacturing Partnership (MMP). A division of the quasi-public Bay State Skills Corp., the MMP is affiliated with NIST's Manufacturing Extension Partnership (MEP), a growing nationwide network of extension services to help smaller manufacturers. The MMP is a five-part network (with regional offices in Dartmouth, Boston, Holden, Lowell and Springfield) that serves more than 10 000 manufacturing companies in the commonwealth. Major industries served include fabricated metals, electronics, plastics, fiber optics, textiles and defense. Federal support for the MMP is provided through the Technology Reinvestment Project (TRP), the government's program to provide funds for dual-use (military and civilian) technology development, deployment and utilization. The current number of centers in the MEP is 44 (37 funded through the TRP), with plans calling for a total of 100 by 1997. For more information on the MMP, contact Sue Paxman at (617) 292-5100.

## LATEST TRP AWARDS FUND NINE NEW EXTENSION CENTERS

Included among the 39 proposals selected for funding on Oct. 25, 1994, under the Technology Reinvestment Project were nine plans for new manufacturing extension centers to be affiliated with NIST's Manufacturing Extension Partnership (MEP). The awards were made to the Southeastern Pennsylvania Manufacturing Extension Partnership, the Northwest Ohio Manufacturing Extension Center, the Manufacturing Modernization Program

for the State of Maine, the Manufacturing Extension Center in North Dakota, the Texas Manufacturing Assistance Center, the West Virginia Partnership for Industrial Modernization, the Manufacturing Extension Program for North Carolina, and two regional offices of the Mid-America Manufacturing Technology Center in St. Louis, MO, and Laramie, WY. For information on the MEP and its extension centers, write to B115 Polymer Building, NIST, Gaithersburg, MD 20899-0001, or call (301) 975-5020.

## FIFTEEN STATES RECEIVE STEP GRANTS FROM NIST

Awards totaling nearly $2 million were recently made to 15 states under the State Technology Extension Program (STEP) component of NIST's Manufacturing Extension Partnership. The awards will help states build their own infrastructure for technology outreach services by (1) planning extension systems or technical assistance programs, (2) supporting the initial implementation of such programs, or (3) developing links between existing programs and those in other regions. STEP grants provide matching funds (the grantee generally is required to put up at least 50 % of the cost of the project) to state governments or public/private, non-profit organizations acting for state governments. The latest awards go to Alabama, Arizona, California, Colorado, Idaho, Nevada, New Hampshire, Puerto Rico, Rhode Island, Utah, Vermont, West Virginia and Wisconsin, and to regional industry efforts located in Maryland and Oregon. For more information on STEP, contact Douglas Deveraux, B115 Polymer Building, NIST, Gaithersburg, MD 20899-0001, (301) 975-5020, e-mail: douglasd@enh.nist.gov (via Internet).

## GET TO KNOW VOLTAGE ARRAYS WITH NEW NIST PAPERS

NIST researchers pioneered the development of voltage standards based on large arrays of superconducting Josephson junctions. Since 1987, the agency has provided 38 10 V arrays for use in various national, industrial and military standards laboratories. Two new technical papers from NIST discuss performance and reliability of these 10 V arrays, as well as a new Josephson circuit that allows rapid selection of voltage steps. The first paper correlates reliability with fabrication technology and projects that new all-niobium arrays will have improved yield and reliability. The new technology offers voltage standards with no rf-induced offsets, trapped flux or sloped steps. The second paper notes that today's Josephson array voltage standards are designed for dc measurements. It describes a new Josephson circuit that allows the rapid selection of any quantum step number. The new circuit will bring the accuracy of the Josephson volt to fast test and measurement systems and ac waveform synthesis. For copies of these papers, listed together as no. 40-94, contact Sarabeth Moynihan, Div. 104, NIST, Boulder, CO 80303-3328, (303) 497-7765, e-mail: moynihan@bldrdoc.gov (via Internet).

## FEBRUARY MEETING HIGHLIGHTS 1994 BALDRIGE WINNERS

Quest for Excellence VII will be the first conference to feature pre-sentations by the three 1994 winners of the Malcolm Baldrige National Quality Award: AT&T Consumer Communications Services, GTE Directories Corp. and Wainwright Industries Inc. Company executives and others from the winning companies will describe their quality improvement strategies and results. The conference also provides an opportunity for people from many different industries and organizations to exchange plans and ideas for quality and business improvements. The conference will be held Feb. 6–8, 1995, at the Washington Hilton & Towers, Washington, DC. To register, contact the Association for Quality and Participation (AQP) at (800) 733-3310 or (513) 381-1959. For additional information on the conference or the Baldrige Quality Award, contact NIST at (301) 975-2036. The conference is co-sponsored by NIST, AQP, the American Society for Quality Control, and the Council on Competitiveness.

## FORTY-SEVEN GRANTS AWARDED IN TWO COMPETITIONS

A robot assistant for surgeons doing hip replacements, genetically engineered cotton plants (for shrink- and wrinkle-resistant fibers), and polymer-based composite materials to replace steel, iron and concrete in automobiles and bridges are among the research goals of 47 new Advanced Technology Program (ATP) projects announced on Nov. 18, 1994. The Commerce Department program, which works with U.S. industry on a cost-sharing basis to develop high-risk, enabling technologies, will commit up to $137 million over 5 years on the new projects, matched by over $158 million from industry. Thirty-two of the 47 projects were selected in the ATP's 1994 general competition (open to

proposals from any area of technology) and represent a planned R&D investment of $186.5 million, with approximately $84.5 million funded by the ATP. The other 15 awards were selected from the ATP Program on Manufacturing Composite Structures, one of five ATP programs focusing on technology areas deemed by industry experts as offering the best opportunities for major economic returns. These projects represent a planned R&D investment of more than $109 million, with approximately $52.5 million funded by the ATP. For a list of the awards, fax a request to (301) 926-1630 or send an e-mail message to: newman@micf.nist.gov (via Internet). This information also is available electronically from the NIST gopher (gopher-server.nist.gov). For information on the ATP, call (800) ATP-FUND (287-3863) or send e-mail to: atp@micf.nist.gov (via Internet).

## PATENT AWARDED FOR POLYMER PROCESSING SENSOR

NIST scientists have been awarded a patent for the development of an optical sensor that can be used to monitor the solidification of polymer resins during processing by injection molding. The sensor operation is based on monitoring fluorescing light from a dye that has been doped into the resin at a very low concentration. The sensor consists of an optical fiber that is inserted into the mold and transmits the fluorescing light to detection equipment. During injection molding, the polymer is heated to the molten state whereupon it is injected into a mold that determines its final dimensions. As the polymer cools, it solidifies by crystallization or glass formation. The time of solidification is important because it signals the time when the part can be ejected from the mold and fresh molten resin can be injected. The technology allows processors to obtain a light intensity versus time profile that characterizes resin cooling and solidification. For information, contact Anthony J. Bur, B210 Polymer Building, NIST, Gaithersburg, MD 20899-0001, (301) 975-6748.

## JOINT NIST/NAVY PROJECT SEEKS TRUSTWORTHY SOFTWARE

NIST and the Naval Surface Warfare Center recently began a collaboration to help ensure the high integrity of computer systems on which the Federal Government and U.S. businesses are increasingly dependent. By working on technologies and supporting computer-aided software engineering tools for the control and operation of a ship's integrated computer system, the partners will evaluate emerging software technologies that may be used for other critical functions in conducting the government's business or enhancing systems in hospitals, factories or financial institutions. Results of the collaboration will be used in conjunction with NIST's efforts in developing standards, guidelines and test methods to advance the capabilities of U.S. industry in software engineering and technology development. For more information, contact Dolores Wallace, B266 Technology Building, NIST, Gaithersburg, MD 20899-0001, (301) 975-3340, fax: (301) 926-3696, e-mail: dwallace@nist.gov (via Internet).

## WHITE PAPERS ON HIGH INTEGRITY SOFTWARE SOUGHT

Software "crashes" can be catastrophic if a computer system contains a company payroll, a transportation schedule or a patient medical record. Such vital data are usually handled by super-dependable programming known as high-integrity software. A NIST-established effort, the Center for High Integrity Software Systems Assurance (CHISSA) is working to ensure that such software is reliable, safe and secure. CHISSA is a public-private partnership designed to help those who research and develop technologies for HISS collaborate with each other. To focus its initial efforts effectively, CHISSA is seeking white papers from organizations using HISS in areas such as manufacturing, education, health care and banking, as well as research organizations with experience developing and testing technologies for them. Although the white papers are not proposals for funding, they should outline CHISSA's role in addressing a current industry need and can identify areas of collaboration. White papers received by Jan. 20, 1995, will help develop CHISSA's initial agenda. For more information or to submit a white paper, contact Dolores Wallace, B266 Technology Building, NIST, Gaithersburg, MD 20899-0001, (301) 975-3340, fax: (301) 926-3696, e-mail: dwallace@nist.gov (via Internet).

## COMMERCIALIZATION OF DENTAL RESEARCH TO BE IMPROVED

NIST and the National Institute of Dental Research (NIDR) have entered into an interagency agreement to enhance NIDR's capabilities in technology transfer to industry. NIDR is one of the National Institutes of Health, Bethesda, MD. Under a two-year agreement, the NIDR extramural

program director for Biomaterials, Pulp Biology, and Dental Implants, who is also a dentist, will work with the NIST Technology Development and Small Business Program to improve federal and industrial commercialization mechanisms for dental research. The initiative will take advantage of NIST experience in the successful transfer of technology from the lab to industry users. During the first phase, factors that effect commercialization will be identified; in the second, recommendations developed in the first phase will be implemented to formulate changes in the process and improve commercialization of new dental and biomaterials. For information on the NIDR Extramural Program, contact NIDR, Rm. 2C35, Building 31, NIH, 9000 Rockville Pike, Bethesda, MD 20892, (301) 496-4261.

## GATT STANDARDS ACTIVITIES REPORTED FOR 1993

A recently published annual report from NIST describes the General Agreement on Tariffs and Trade Standards Code activities conducted by the agency during calendar year 1993. The NIST Standards Code and Information Program (SCIP) supports industry with information on standards and certification information activities that might affect U.S. trade. SCIP received and processed 487 notifications of proposed technical regulations; reported 59 proposed U.S. technical regulations to the GATT Secretariat in Geneva; responded to 352 inquiries for GATT notification information; participated in various bilateral and multilateral standards-related trade discussions; and responded to more than 9500 inquiries on the existence, source and availability of standards and standards-related information. SCIP operates a GATT "hotline" on proposed foreign regulations at (301) 975-4041, and a European Community "hotline" with information on draft European Union documents at (301) 921-4164. To obtain the report, GATT Standards Code Activities of the National Institute of Standards and Technology 1993 (NISTIR 5458), send a self-addressed mailing label to the SCIP, A163 Building 411, NIST, Gaithersburg, MD 20899, (301) 975-4037, e-mail: overman@micf.nist.gov (Internet).

## PUBLICATION HIGHLIGHTS NIST/INDUSTRY SUCCESSES

A new booklet available from NIST's Public Affairs Division chronicles 32 examples in which U.S. companies and the agency have crossed paths to their mutual benefit. NIST Industrial Impacts: A Sampling of Successful Partnerships (NIST Special Publication 872) presents case studies in all four major programs of NIST's portfolio for working with industry: the Advanced Technology Program, the Manufacturing Extension Partnership, the Malcolm Baldrige National Quality Award and NIST's laboratory services. For a free single copy of NIST SP 872, send a self-addressed mailing label to the Public Affairs Division, A903 Administration Building, NIST, Gaithersburg, MD 20899-0001. The document also is available electronically from the NIST gopher (gopher-server.nist.gov).

## NIST-INDUSTRY COLLABORATION SHOWS NEW MULTILAYER THIN-FILM SYSTEMS MEET CRITICAL REQUIREMENTS FOR USE IN MAGNETIC READ-HEAD SENSORS

NIST and a private company have shown that magnetic read head structures made from the recently announced NiFe-Ag multilayer thin-film systems exhibit low magnetostriction as well as impressive sensitivity in low magnetic fields. A key factor in the quest to increase storage density in magnetic systems, such as computer hard drives, is improvement of the sensitivity of the magnetoresistive heads used to read the storage medium. However, a very sensitive head that poses difficulty in manufacture or that is not reliable under the conditions of use is no improvement. Magnetostriction is a critical parameter for the successful manufacture of magnetic read heads and must be maintained very close to zero to prevent strain-induced noise and sensor deterioration from occurring during operation. NIST and private industry scientists tested the performance of NiFe-Ag systems. They first grew NiFe-Ag multilayer films on both NIST silicon wafers and on composite aluminum oxide/titanium carbide substrates provided by the company. Following dicing and annealing, the magnetoresistance of the resulting specimens was measured at NIST and the magnetostriction of the specimens at the company. Annealing is necessary for the NiFe-Ag multilayers to exhibit giant magnetoresistance (GMR). The team was able to identify an optimal annealing temperature, which results in zero magnetostriction concurrent with GMR behavior and high sensitivity in low magnetic fields.

## PRIVATE COMPANY SELECTS NIST SOFTWARE AS BASIS FOR IMPROVING CAPABILITIES OF DIELECTRIC PROBE KIT

A private company has chosen to adapt NIST software developed for measurements made with an open-ended coaxial probe for use with one of the company's probe kits. The Dielectric Probe Kit is intended for the measurement of the dielectric properties of materials and for testing materials with respect to dielectric properties. A major advantage of the NIST software program is that it provides correction for the presence of any air gap between the material being measured and the probe. If an air gap is present and the results are not corrected, serious measurement errors will result. As applied to the kit, the correction capability means that kit users for the first time have the option of making noncontacting measurements, with the probe positioned at a small, but finite, distance from the material being measured. This capability is especially advantageous for automated or other rapid materials testing in which the probe passes over the materials under test.

The software, which offers a number of other enhancements not previously available to users of the kit, provides for accurate nondestructive radio-frequency characterization of the complex permeability and permittivity of materials having both magnetic and dielectric properties of interest. The software code is based on full-wave theory, rather than on conventional equivalent lumped-circuit models, which yield increasingly inaccurate results with increases in frequency. The use of full-wave theory provides for the presence of a number of boundaries, such as those arising from a finite layer thickness for the material under test, the presence of conductive backing (in the case of metalized substrates) and, as noted above, the presence of an air gap.

## NIST LASER POWER AND ENERGY MEASUREMENT SERVICE EXTENDS TO ULTRAVIOLET WAVELENGTHS WITH EXCIMER LASER CAPABILITY

In response to numerous requests from excimer laser users in industry who require accurate and traceable measurements, NIST researchers, working in collaboration with SEMATECH, have established the measurement capability to calibrate power and energy meters for detecting KrF excimer laser radiation at a wavelength of 248 nm. Measurements in this wavelength region are needed in particular by users and manufacturers of excimer-based semiconductor photolithography systems and by manufacturers and users of all excimer laser measurement equipment. The new capability represents a significant extension of the NIST laser measurement service to ultraviolet laser wavelengths. The measurement system was developed and characterized by the division with SEMATECH support and consists primarily of standard isoperibol calorimeters along with a calibrated fused-silica beamsplitter. SEMATECH has provided the calorimeters and associated data acquisition system to NIST under a long-term loan agreement and also provided software support to adapt this system to NIST use.

## INSIGHTS GAINED ON THE ORIGIN OF RESISTANCE IN CONTACTS TO HIGH-TEMPERATURE SUPERCONDUCTORS

NIST scientists have carried out studies whose results have important implications for the technology of making contacts between high-temperature superconductors and normal metals. Many applications of high-temperature superconductors require the formation of low-resistance interfaces between the superconductor (S) and a normal metal (N), and there is a constant effort to form cleaner, more reproducible interfaces.

As a consequence of their studies, the team has identified the mechanisms by which electrical current is conducted across interfaces between superconducting $YBa_2Cu_3O_{7-\delta}$ (YBCO) and noble metals (Ag, Au, Pt). These are direct quantum-mechanical tunneling and tunneling assisted by magnetic scattering. This insight impacts the development of contact technology and superconducting microelectronic device technology based on S-N interfaces in three ways:

- Tunneling was observed for a wide variety of YBCO/noble-metal interfaces, including those exhibiting contact resistivities in the $10^{-8}\,\Omega\,cm^2$ range, which is considered to be adequately low, but not optimally low, for some contact applications. This means that the relatively "clean" interfaces formed in situ have an insulating barrier layer between the superconductor and noble metal, suggesting that a more stringent control of the processing parameters might prevent formation of the barrier layer and result in even cleaner interfaces having much lower contact resistivities.
- The presence of the tunneling assisted by magnetic scattering, which accounts for up to 25 %

of the interface conductance for the in situ contacts, indicates that isolated magnetic spins are located at the interface and may be intrinsic to the YBCO without strain relief.

- Ex situ interfaces, in which YBCO surfaces were systematically exposed prior to normal-metal deposition, showed the same conductance features as the in situ interfaces. These interfaces included those exposed to air, $CO_2$, $N_2$, vacuum, or chemical or ion etching and exhibited contact resistivities up to $10^{-3}\ \Omega\,cm^2$. From an engineering standpoint, the most encouraging ex situ interface result was that the increase in contact resistivity upon air exposure occurred at a relatively slow rate, with a 100 m air exposure resulting in a contact resistivity of $10^{-7}\ \Omega\,cm^2$.

## AGREEMENT WITH PRIVATE COMPANY TO FOSTER MICROELECTRONIC PACKAGING CHARACTERIZATION

NIST has entered into a Cooperative Research and Development Agreement (CRADA) with a private company, to develop a method for transmission line characterization using time domain instrumentation. The cost and electrical performance of computers, portable telecommunication devices, and other modern electronic systems are increasingly limited not by the performance of integrated-circuit (IC) chips but by the chip package, which provides means for electrical connection to the chip from other ICs and other circuit elements, in addition to physical and electrical protection. Accurate computer-aided design of advanced packages requires accurate measurements of the signal propagation characteristics of the package interconnections. The CRADA responds to the need for accurate, yet simple and inexpensive, means suitable for use by industrial laboratories to characterize electrical interconnects in microelectronics packaging. Under the CRADA, the private company has provided NIST with its commercial interconnect parameter analyzer for use in developing methods and software to determine important frequency-domain transmission line parameters, including propagation constant, attenuation, and characteristic impedance. NIST's role is to evaluate fundamental limitations in the hardware and develop methods to correct for systematic errors. The result will be improved package characterization methods that can be used by industrial laboratories with common laboratory instruments.

## NIST AND PRIVATE COMPANY SIGN CRADA TO DEVELOP NIST-TRACEABLE REFERENCES

NIST has recently signed a Cooperative Research and Development Agreement (CRADA) with a private company, with the goal of acquiring specimens of ceramic and ferrite materials that can be characterized and then serve as reference specimens at both NIST and the company. The company, a major supplier of ceramics and ferrites for the electronics and communication industries, will supply NIST with up to six specimens of each material to be measured. Under the terms of the CRADA, half of the characterized specimens will be returned to the company; NIST will retain the remaining specimens to use as in-house reference materials. To date, NIST has measured the complex permittivity of several of the company's ceramics in the radiofrequency spectral range 0.8 GHz to 10 GHz. The agreement also covers complex permeability measurements of low-loss ferrites in the range 2 GHz to 20 GHz. The relative permittivity values of the ceramics being tested range from 4 to 90, with loss factors ranging from $2.4\times10^{-5}$ to $6.9\times10^{-4}$.

Two very different methods are being used to perform the characterization measurements. One involves the NIST-developed mode-filtered, 60 mm diameter cylindrical cavity that is capable of providing high- accuracy measurements at frequencies near 10 GHz. The other involves a modified form of the Courtney/ Hakki-Coleman dielectric rod resonator, in which a right-circular cylinder of the material under test is mounted between two conducting ground planes, and a small air gap is introduced between the sample and the upper ground plane in order to change the resonant frequency. Uncertainty budgets will be developed and compared for both methods.

## MICROMETER ENTERS FINAL TEST STAGE

The Y-12/NIST long waybed micrometer is complete and has entered the first test stage. The micrometer, a jointly developed project between the Oak Ridge Center for Manufacturing Technology and NIST provides high-accuracy length measurements on end standards up to 1.2 m in length. Early tests showed a one standard deviation reproducibility of 0.025 μm on end standards up to 500 mm. A study of the contact deformation for different materials used for end standards is under way. When testing is finished, NIST plans to include the long waybed micrometer calibration service as part of the calibration program.

## PROGRAM ESTABLISHED FOR INTERCOMPARISON OF PRIMARY GAS STANDARDS WITH NETHERLANDS MEASUREMENT INSTITUTE

A memorandum of understanding has been signed between NIST and the Netherlands Measurements Institute located at Delft, The Netherlands. This agreement lists the terms and conditions of an intercomparison study to be carried out between the two institutes on Primary Standard Gas Mixtures (PSM). To facilitate international trade, national standards laboratories worldwide need to intercompare chemical standards so that traceability links can be established across international boundaries. For example, gas standards needed by a U.S. company to satisfy an environmental regulation in Europe could be procured from a U.S. gas supplier if a traceability link was established between those gas standards, through NIST, and then to the European standards. Another possible benefit would be gained if each national standards laboratory were to specialize in certain standards, thus eliminating the need to stock those standards at other national standards laboratories. This would allow scarce resources to be redirected to generate the new standards needed by industry worldwide. One goal of the study is to enable a Declaration of Equivalence to be signed stating that certain PSM suites are equivalent, paving the way for traceability links between the United States and Europe. Another equally important goal is to help verify the validity of the two institutes' primary gas standards by cross checking analyzed values.

The initial PSM suites to be studied are sulfur dioxide ($SO_2$), nitric oxide (NO), hydrogen sulfide ($H_2S$), propane, oxygen ($O_2$), carbon monoxide (CO), and carbon dioxide ($CO_2$). Studies completed in previous years have found certain PSM suites to be equivalent. These are the $CO_2$ in nitrogen ($N_2$), propane in $N_2$ and the CO in $N_2$ suites, and are currently listed in the first Annex to the Declaration of Equivalence.

## REAL-TIME MEASUREMENT OF METALORGANIC PRECURSORS FOR METALORGANIC CHEMICAL VAPOR DEPOSITION REACTORS

Researchers at NIST in collaboration with a private company, have demonstrated a new on-line control capability for metalorganic chemical vapor deposition (MOCVD) reactors. Simultaneous concentration measurements were made, by means of Fourier transform infrared (FTIR) spectroscopy, of two MOCVD precursor agents in multicomponent flow systems simulating actual MOCVD reactor streams. The study's objective, in addition to the basic demonstration of satisfactory spectroscopic resolution of two components, was the determination of measurement times. To be useful for feedback-control purposes of MOCVD reactors, the measurement should allow repetition rates of at least 1 Hz. Two agents, trimethyl aluminum (TMA) and triethyl gallium (TEG), were studied in a specially constructed flow system at concentrations and flow rates used in actual reactors. FTIR absorption spectra of various mixtures of the two agents were acquired with spectral resolutions from $2\ cm^{-1}$ to $16\ cm^{-1}$. Mass fractions of the metalorganic species ranged from 200 μg to 14 000 μg/g. Reliable simultaneous mass fraction measurements were possible down to 500 μg/g. Average measurement errors in streams containing mixtures of the two species (relative to calibration data established for individual components) were −4 % and +1 % for TMA and TEG, respectively. Absorption spectra could be acquired at rates up to 4 Hz, well within the real-time control requirements. Post processing of data with the existing laboratory software was much longer. Thus, application to actual reactors will require more rapid processing of the data.

A description of the measurement technique, first presented at the 8th International Forum of Process Analytical Chemistry in January 1994, is the feature article in the Summer 1994 issue of Metalorganics News.

## INFRARED SOURCE BASED ON DIFFERENCE-FREQUENCY MIXING OF LASER RADIATION

In a paper recently accepted by the Journal of the Optical Society of America, researchers at Rice University and NIST describe the collaborative development of a system for generating tunable, coherent infrared radiation near 3 μm by difference-frequency mixing the outputs of two solid-state lasers. The specific experiments reported involve the mixing of radiation from a diode laser and a diode-laser-pumped Nd:YAG laser. They report an output of more than 2 μW of cw radiation in the range from 3.155 μm to 3.423 μm. This spectral region has not been accessible using simple, compact radiation sources, and it is of very high interest because it covers many important carbon-hydrogen stretch absorption lines. To demon-

strate the spectroscopic capabilities, the group used their system to detect fundamental stretch vibration modes of methane by both direct and wavelength-modulation absorption spectroscopy. These experiments used high-resolution scans of the difference frequency of about 30 GHz ($\sim 1\ cm^{-1}$).

This type of radiation source should prove useful in a variety of applications, including the trace detection of important organic molecules. There are very few sources available in this spectral region, and those that do exist tend to have poor spectral quality and be expensive and large. This work demonstrates the feasibility of one of a class of future sources exhibiting simplicity, low power consumption, small size, and wavelength tunability. The concepts will most certainly be extended to other frequency regions.

## METALLURGY DIVISION TO PROVIDE MODELING EFFORT FOR USCAR

At the request of the U.S. Council for Automotive Research (USCAR), NIST has developed a program based on its previous research aimed at modeling the consolidation of aluminum/SiC powders into complex shapes such as those used in the engines of cars. In the last year, USCAR has identified the development of low-cost technologies for the production of particle-reinforced aluminum as an important element in future car making activities. An extensive program was developed, one element of which was modeling. Modeling provides the car manufacturers and their suppliers with a rapid, inexpensive (compared to traditional methods) procedure for designing dies and establishing heating and pressing schedules for powder consolidation. In the past decade, NIST has been advancing various scientific fronts in metal powder technology. Based on NIST's background in this area, NIST was asked to propose a research program that would provide industry with working and validated models for the materials of interest. The proposed effort, will include extensive university collaboration, development of instrumented powder consolidation systems, and advanced measurements and methods.

## NIST ASSISTS INDUSTRY IN RHEOLOGICAL MEASUREMENTS

NIST scientists are working with a major supplier of rheological instruments to the polymer industry to improve the accuracy of certain rheological measurements. Industry uses flow data on polymers to determine processing parameters and performance characteristics. Rheological measurements on polymers often involve three or four orders of magnitude variation in material response in a single experiment. Accurate measurements require both good temperature control of the sample and excellent long-time zero stability of the force transducer. One solution to the zero stability problem was the development of a force rebalance transducer (FRT), which was adapted by a private company, to produce an instrument with excellent zero stability compared to those of other vendors.

Researchers at NIST discovered anomalies in the measurement of normal forces of stiff samples with the FRT, and they determined conditions under which accurate measurements could be made. The company sought assistance from NIST to inform, via joint publications and presentations at technical meetings, the polymer industry of potential pitfalls in normal force measurements with the FRT as well as methods to correct for the problem until a change in the hardware can be produced.

## MORPHOLOGY CHANGES IN COPOLYMER FILMS

NIST scientists in collaboration with scientists from a private company and MIT have reported the first experimental evidence of morphological orientation changes in thin films of diblock copolymer confined between two walls. Diblock copolymers consist of two chemically distinct polymer chains called "blocks" covalently bonded together to form a single chain. Since the physical and chemical properties of the two blocks can be very different, these materials find wide industrial application in custom engineered coatings and as compatibilizers in polymeric composites. Many potential engineering applications of copolymers envision their use in thin polymeric films, which bridge dissimilar materials. Neutron scattering experiments to study copolymer films confined between surfaces of varying physical and chemical properties recently were carried out at the NIST Cold Neutron Research Facility. The scientists developed a technique to prepare surfaces with a varying affinity for a specific block by coating them with a random copolymer having the same constituent chemical species found in the diblock copolymer film. By combining neutron reflectivity and small-angle neutron scattering, they were able to observe a change in the lamellar domain orientation in the copolymer film from perpendicular to the walls to parallel to the walls as the surface

chemical properties of the wall were modified to promote specific adsorption of one of the blocks. Such results can greatly improve understanding of the wetting behavior of copolymer films and hence their use as surface modifiers and compatibilizers in technological applications.

## NIST WORKSHOP ON IMPROVING VENTILATION EVALUATION

NIST held a workshop on approaches to improving ventilation evaluation in commercial buildings on Sept. 23, 1994. This workshop was held as part of a larger effort intended to identify tools and approaches needed to improve the reliability, consistency, and completeness of these evaluations. While the evaluation of building ventilation is critical to building operation and maintenance, investigations of indoor air quality, energy audits and research, many such endeavors do not employ reliable or appropriate approaches to ventilation evaluation. For example, many efforts to diagnose the causes of indoor air quality complaints in buildings give inadequate attention to ventilation system performance, making it difficult to interpret other indoor environmental parameters. In other cases, procedures used to evaluate ventilation are not suited to the ventilation system design and operation or the building in question. To improve the reliability of ventilation evaluation in commercial buildings, NIST is undertaking a project to identify research and technology-development needs to make further advances in the field and to develop selected ventilation assessment protocols.

The workshop was held at NIST to discuss the current state-of-the-art in building ventilation evaluation and the reasons for deficiencies in these evaluations. Specific approaches to correcting these deficiencies, such as the development of standardized protocols, new instrumentation, and research, also were discussed. The workshop participants included instrumentation manufacturers, representatives of heating and air-conditioning-related industries, several private indoor air quality consultants, and researchers.

## NIST MEASURES SMOKE FROM IN SITU BURNING OF CRUDE OIL EMULSIONS

Alaska Clean Seas, an industry-sponsored oil spill response cooperative, conducted a series of in situ emulsified crude oil burns near Prudhoe Bay, Alaska, in September 1994. NIST, in cooperation with Alaska Clean Seas, the Environmental Protection Agency, and the National Oceanic and Atmospheric Administration, conducted smoke measurements consisting of carbon dioxide and particulate concentrations in close proximity to the fire and particulate concentrations downwind of the fire.

The results of the experiments will assist in determining the suitability of the in situ burning response technique for particular spill situations and provide verification information for the large eddy simulation downwind smoke dispersion model under development at NIST.

## COMPUTER SECURITY CONFERENCE ATTRACTS LARGE TURNOUT

On Oct. 11–14, NIST and the National Security Agency's National Computer Security Center (NCSC) co-sponsored the 17th National Computer Security Conference in Baltimore, MD. The theme of the conference was "Communicating Our Discipline: Strategies for the Emerging Information Infrastructure." The conference attracted about 2000 attendees from government and industry.

Keynote speaker, Sally Katzen, administrator, Office of Information and Regulatory Affairs, Office of Management and Budget, reaffirmed the commitment to security as a key component of the National Information Infrastructure (NII) and the need for users to take responsibility for the security of their information and systems.

The conference featured five tracks, which addressed traditional information security concerns as well as security issues associated with the emerging information infrastructure. Topic areas included risk management, network security, formal modeling criteria development, product development, system integration, new security paradigms, privacy, computer crime, and ethics. Sessions on security education, training, and awareness were hosted by the Federal Information System Security Educators' Association. There was also a special session to update attendees on the status of the Digital Signature Standard. The closing plenary focused on "Security, Privacy, and Protection Issues in Emerging Information Infrastructures."

## NIST ASSISTS ANSI STANDARDS PANEL

NIST staff members contributed to the working meeting of the Information Infrastructure Standards Panel (IISP) held in McLean on Sept. 27–28. The IISP is a new organization formed by the American National Standards Institute to focus on accelerating the development of standards critical to the implementation of the National and Global

Information Infrastructures. Representatives from the computer, communications, cable, software, cellular, satellite, and broadcast industries, and from government, standards developers, consortia, and other organizations participated in the meeting.

The meeting opened with presentations on model architectures for the NII that had been developed by several organizations. These presentations were followed by seven breakout sessions that addressed common principles of understanding, architectural analysis, standards development and tracking, user requirements, international aspects, cross industry understanding, and the role of government in the NII and GII.

The seven groups developed recommendations for future activities and identified issues and challenges for consideration and action. NIST staff members will continue to support some of the ongoing work groups, including the architectural analysis group. ANSI will issue a summary report on the meeting.

### NIST ESTABLISHES DISTRIBUTED CENTER OF EXCELLENCE

The Center for Applied Information Technology (CAIT) has been established at NIST as a visionary, collaborative approach to re-engineering the process of technology transfer through the use of information technology resources such as the National Information Infrastructure. The CAIT, with industry participation, will develop a nationwide network of interconnected research, development, and technology transfer centers located at key government, industry, and university sites.The center will pursue electronic solutions to industry-defined problems in application areas such as manufacturing, collaborative engineering, health care, electronic commerce, nationwide multimedia libraries, education, environmental monitoring, and improved global communications.

### REPORT FOCUSES ON SOFTWARE TECHNOLOGY REQUIREMENTS OF U.S. INDUSTRY

NISTIR 5500, Report on the Advanced Software Technology Workshop, presents results of an invitational workshop held at NIST in February 1994. A NIST manager convened the meeting of 11 executives for whom software is critical to business. Led by a representative of one of the participating companies, the group identified advanced software technology requirements for U.S. business and opportunities that NIST might pursue in the area of advanced software technology.

### NIST SPONSORS TRAINING FOR FEDERAL AGENCIES ON INTERNET SECURITY

On Oct. 28, NIST conducted a training session on security issues involved in connecting to the Internet and managing systems and sites that are part of that network. Topics covered included securing connections to the Internet, obtaining patches, and detecting suspicious activity. About 75 representatives from federal agencies attended the training. Additional training opportunities can be found in NISTIR 5495, Computer Security Training & Awareness Course Compendium.

## Standard Reference Materials

### NEW PRECISION ARTIFACT HELPS CMMs MEASURE UP

With a new NIST Standard Reference Material, manufacturers can evaluate the point-to-point probing performance of coordinate measuring machines (cmm, devices used to inspect the geometry of parts and assemblies). The SRM supports portions of a national standard (American Society of Mechanical Engineers ASME B89.1.12M 1990) specifying testing methods for assessing the performance of CMMs and their subsystems. The precision artifact enables evaluation of the probing subsystem—probe, indexable probe head, probe changer and stylus. Besides standard point-to-point probing and repeatability tests, the SRM can be used to assess multitip-probing and contact-scanning performance and the repeatability of probe and stylus changers. SRM 2084 consists of a tungsten carbide sphere—measuring 10 mm across and calibrated for roundness and diameter—along with accessory hardware. The sphere is mounted on a tungsten carbide stem atop a stainless steel stand that fastens to the CMM table. An optional 25 mm diameter stainless steel sphere (SRM 2085) also is available. SRM 2084 is available for $1,556 from the NIST SRM Program, 204 Engineering Mechanics Bldg., Gaithersburg, MD 20899-0001, (301) 975-6776, fax: (301) 948-3730.

**STANDARD REFERENCE MATERIALS 2286 THROUGH 2293—OXYGENATES IN GASOLINE**

The Clean Air Act (CAA) Amendments of 1990 set specific regulations on emissions from gasoline. In addition, on Dec. 15, 1993, the U.S. Environmental Protection Agency (EPA) issued a final rule on reformulated gasolines. The aim of this rule, which takes effect Jan. 1, 1995, is to reduce VOCs (volatile organic compounds), which carry a high ozone pollution rate. NIST was requested to provide industry with a con-trolled standard to verify the measurement of oxygen in all gasolines produced and sold in the United States.

The Standard Reference Materials Program has announced the availability of eight SRMs, 2286 through 2293, Oxygenates in Gasoline. The reference materials are solutions of oxygenate gravimetrically added to a baseline gasoline. Each is certified for its constituent oxygenate concentration and the resultant oxygen concentration in gasoline.

Each SRM unit consists of two ampoules containing approximately 18 mL of oxygenate in gasoline solution and one ampoule containing a similar amount of the base reference gasoline.

**STANDARD REFERENCE MATERIAL 1570A—TRACE ELEMENTS IN SPINACH LEAVES**

To determine any adverse long-term public health effects of potentially toxic elements in botanical foodstuffs, the Food and Drug Administration (FDA) requested NIST to develop a spinach leaves SRM having certified concentrations for trace elements of nutritional and toxicological significance.

The Standard Reference Materials Program has announced the availability of SRM 1570a, Trace Elements in Spinach Leaves, which consists of a 60 g unit of dried spinach leaves. SRM 1570a is a renewal lot of SRM 1570, which was initially issued in 1976. This SRM is for use as an analytical control material and for evaluating the reliability of analytical methods for the determination of major, minor, and trace elements in botanical materials, agricultural food products, and similar matrices. SRM 1570a is certified for 20 constituent elements. These concentrations are based on the agreement of results from at least two independent analytical methods of known accuracy.

The current availability of other botanical SRMs for trace elements includes SRM 1515—Apple Leaves, SRM 1547—Peach Leaves, and SRM 1573a—Tomato Leaves.