

# News Briefs

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## General Developments

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

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### NIST DEVELOPS TEST CHIP FOR MEASUREMENTS OF MMIC PACKAGES AND INTERCONNECTS

NIST scientists have invented a method for measuring the effect of a monolithic microwave/millimeter-wave integrated-circuit (MMIC) package or interconnect on microwave signals passing through it. This information is needed by MMIC designers to separate the effects of the package or interconnect from measurements intended to characterize a MMIC chip. The test vehicle is itself a microchip carrying a coplanar transmission line with a beam-lead diode that can be biased at different levels. To make measurements of packages or interconnects, this test chip replaces a MMIC chip. For example, to characterize a package designed to house and protect a single MMIC chip, the test chip would be mounted in a specimen of the package and connections made to it in, as nearly as possible, the same way that connections would be made to the MMIC chip. The bias for the diode would be applied directly through the radiofrequency connections of the package. Scattering parameter measurements would then be made at the coaxial connections of the package. The package effects then could be determined from the results of these measurements and a prior characterization of the diode.

The term interconnect as used here refers to a structure that transduces a microwave signal from one transmission medium to another. Examples

include coaxial to coplanar waveguide, coaxial to microstrip, and microstrip to coplanar waveguide.

### FIIA SYSTEM FIELD-TESTED FOR THEOPHYLLINE IN SERUM AT NIST

A new concept for the measurement of a wide variety of clinical analytes in blood serum, flow injection immunoassay (FIIA), has been recently developed by researchers at NIST. FIIA promises to improve measurements in three ways: by allowing the reuse of expensive antibody reagents, by increasing the assay sensitivities, and by providing the opportunity for automation. The FIIA system was successfully tested for the determination of serum theophylline, a drug which is administered for the treatment of asthma. The performance of the theophylline FIIA for a large number of samples was compared to a fluorescence-polarization immunoassay and to liquid chromatographic determination. There was excellent agreement among the three techniques.

The primary component of the FIIA system is a regenerable reactor column that has the antibody reagent bound to a bed of silica particles. This immobilization provides a site in the flowing system for the specific reaction with the antigen and stabilizes the expensive antibody component for hundreds of measurement cycles. Detection of the immunochemical interaction between the analyte and antibody is achieved by use of theophylline-tagged liposomes, submicroscopic particles capable of encapsulating thousands of fluorescent markers which can be released for detection in the flow system. This provides a very sensitive test that requires much smaller blood volumes than currently used assays, a definite advantage for monitoring therapy in small children. All steps in the assay sequence are automated using a flow injection system under computer control.

**NON-METHANE ORGANIC COMPOUND (NMOC) GAS STANDARDS DEVELOPED TO SUPPORT ATMOSPHERIC MEASUREMENTS OF AUTO EMISSIONS**

Scientists at NIST have developed a series of gas mixtures consisting of trace level concentrations of 15 different organic compounds in nitrogen. The compounds are constituents of automobile exhaust and have been identified as reactants in the formation of ozone. The standards are difficult to produce since some of the reference compounds are gases, while others are liquids under normal conditions. Because of the low concentration levels, approximately 5 parts per billion (ppb), special procedures had to be developed to accurately produce the mixtures and preconcentrate the organic constituents to allow detection for analysis.

These standards are required to better understand and follow the complex atmospheric chemistry of ozone formation. Ozone at high altitudes is essential to regulating the Earth's atmosphere. However, ozone at ground level is a pollutant that adversely effects human health and is a major contributor to plant and crop damage. Ground-level ozone is formed by complex interactions involving hydrocarbons, oxygen, and sunlight, and is one of the constituents of photochemical smog. Current concern with high pollution levels has caused environmental agencies to embark on studies to determine sources and levels of pollutants so that they might recommend remediation steps and then measure whether these steps are effective. The standards developed at NIST contain the hydrocarbon compounds involved in the reactions to form ozone and will be used to calibrate instruments for accurately measuring these components in the atmosphere.

**TWO NEW NIST PRECISION MEASUREMENT GRANTS AWARDED FOR FY 92**

Two new \$30,000 NIST precision measurement grants have been awarded for fiscal year 1992. The recipients, Daniel J. Heinzen of the University of Texas at Austin and Carol E. Tanner of the University of Notre Dame, were selected from an initial group of 42 candidates. NIST Sponsors these grants to promote fundamental research in measurement science in U.S. universities and to foster contacts between NIST scientists and researchers in the academic community actively engaged in such work.

Heinzen's project, "Quantum-Limited Cooling and Detection with Stored Ions," involves new ion

trapping and cooling experiments with the aim of extending recently developed quantum-limited cooling and detection techniques to a wider variety of ions and to protons and electrons. The ultimate goal is to increase the accuracy of mass ratio and electron and positron  $g$ -factor measurements to unprecedented parts in  $10^{11}$ – $10^{12}$  range.

Tanner's project, "Absolute Calibration of Atomic Parity Nonconservation Measurements," will focus on measuring the transition probability or strength of a particular transition in the cesium atom with an accuracy never before achieved. This will allow the detailed interpretation of new atomic parity non-conservation experiments in cesium, experiments that, because of their high accuracy and low-interaction energy, will probe the standard model of the weak interaction or force at a level that can test it critically and search for new physical effects.

**SILICON PHOTODIODES OPERATE OVER 14 DECADES OF DYNAMIC RANGE**

The improvements in commercial silicon photodiodes and operational amplifiers over the past several years permit optical power measurements over a wider dynamic range. In a recently published study, scientists at NIST analyzed in detail the origin of noise and drift in certain photodetector circuits and showed that, with the careful selection of components, a simple detector can operate over a dynamic range of 14 orders of magnitude. With a measurement time of 400 s, the electrical noise can be reduced to an equivalent photocurrent of 0.1 fA (fewer than 800 photons/s). At the other extreme, the same sensor without attenuation can measure mW of power.

This wide range of operation is important because the primary NIST radiometric standards have a much narrower range of operation and there is an operational need to transfer primary calibrations to other instruments with different sensitivities. The 14-decade detectors are well suited for this purpose. For example, laser-based facilities may be compared to lamp- and monochromator-based facilities. In one project, the 14-decade detectors facilitated the calibration of night-vision equipment against NIST incandescent lamp standards.

There are a large number of other applications where such a silicon photodiode circuit could replace large and expensive photomultiplier tubes, or inspire new, better, or less expensive products. There is an increasing demand for sensitive radiant

power measurements in such diverse fields as chemiluminescence and bioluminescence, materials science (optical density and surface scatter), and optical communication.

#### **X-RAY DIFFRACTION IMAGING OF ARTIFICIAL DIAMOND SINGLE CRYSTALS**

Diamond single crystals possess many remarkable properties, such as the highest thermal conductivity and the highest hardness of any material. These properties make diamonds an attractive material for high technology applications such as laser and x-ray windows and high temperature electronic devices. Natural diamonds are recognizable individuals, each with its own set of defects. Since electronic properties are influenced by crystalline perfection, the properties of one crystal are not necessarily the same as those of another crystal. Therefore, the intrinsic properties of diamonds are difficult to determine by analysis of natural crystals.

The high temperature/high pressure process for growing single crystal diamond that was invented by a well known U.S. industrial firm in 1970 has improved to the point where single crystals can be grown that exceed the quality of naturally occurring crystals. These crystals may provide the best opportunity to establish the intrinsic properties of diamonds. In collaboration with this firm, scientists at NIST have been investigating the quality of artificial diamonds by x-ray diffraction imaging, and in particular the influence of isotopic concentration on crystal quality. Using the MSEL beamline at the National Synchrotron Light Source at Brookhaven National Laboratories, NIST scientists examined several natural type IIa (lowest nitrogen concentration) diamonds and several artificial type IIa and IIb (boron doped) diamonds with varying carbon-<sup>12</sup> and carbon-<sup>13</sup> isotope concentration. The results indicate that diamonds grown from pure <sup>12</sup>C stock can have a higher degree of crystallographic perfection than comparable crystals with isotopic concentrations identified to natural crystals.

#### **SENSORS IDENTIFIED FOR POLYMER COMPOSITE PROCESSING**

The driving force for process control sensors is the need for the U.S. polymer composites industry to improve the efficiency and reliability of fabrication to increase competitiveness. The most promising on-line sensor techniques are ultrasonic, dielectric, spectroscopic, and optical. NIST researchers identified and analyzed these process control methods

in a report, *Assessment of the State-of-the-Art for Monitoring Sensors for Polymer Composites* (NISTIR 4514). Each sensor technique was evaluated for measurement speed, sampling geometry, sensitivity to different resins, effects of fiber type, interpretation of the data, and sensitivity to the manufacturing environment. The future for process control is very bright, but the major short-term needs are to build more rugged and reliable equipment that can withstand the harsh manufacturing environment and to develop better relationships between sensor data and the information needed for process control.

#### **DAMAGE IDENTIFICATION IN CYCLICALLY LOADED PZT TRANSDUCERS**

Catastrophic failure limits the application of brittle, ceramic materials; consequently, their fracture behavior has been intensely investigated. There exist a number of applications of ceramics, however, in which components are subjected to cyclic, rather than static or monotonically increasing, loads. One such application is the use of piezoelectric ceramics as transducers, in which the material undergoes large cyclic strains, often at resonance frequency. NIST investigations of lead zirconate titanate (PZT), a commercial transducer material, have shown that microcracks are generated during cyclic loading. These cracks do not link up at lower temperatures (e.g., at  $T \sim 80^\circ\text{C}$ ) but, at higher temperatures, may cause hundreds of micrometers of crack extension, which can eventually lead to mechanical failure. If the temperature of the specimen under load is allowed to rise above  $\sim 100^\circ\text{C}$ , the material fails catastrophically. While these results explain the lower strengths of PZT driven at resonance frequency, the fracture process is not yet understood. This understanding will be critical for the design of reliable, higher power devices.

#### **NIST PARTICIPATES IN THE UNITED NATIONS ASSESSMENT OF THE INTERNATIONAL CFC TREATY**

A NIST scientist was a principal author of a technology review report for the United Nations. This report assessed the impact of the planned phase-down of environmentally unacceptable chlorofluorocarbons (CFC) on chilled water systems for commercial building air conditioning. The Contracting Parties of the Montreal Protocol, signed in September 1988 and updated in London in 1990, will meet in Copenhagen in 1992. At that time, the group will likely make decisions for an

accelerated phase-out of CFCs and new plans to phase-out partially halogenated compounds (HCFCs). This decision will be based on an extensive number of reports summarizing all current knowledge on ozone sciences effects, technology, and economics. The NIST scientist and representatives of the three largest air conditioning manufacturers assessed the technology of large building air conditioning. They concluded that: (1) no substitute is currently known for HCFC-22 or HCFC-123, and (2) currently used HCFCs and HFC-134a must be available until 2020 AD (the generation of current equipment lifetime) if alternatives exhibiting equal or better performance and acceptable system cannot be found.

#### **NEW PUBLICATION FOCUSES ON MICROCOMPUTER-BASED EXPERT SYSTEM BUILDING TOOLS (ESBTs)**

Recent years have seen substantial growth in the number of expert systems being developed and fielded in the microcomputer environment. To a great extent, this growth is due to the advent of ESBTs designed for use on microcomputers. Sometimes known as expert system shells, ESBTs are special-purpose software packages that are used to develop expert systems. NIST Special Publication 500-188, Guide to Expert System Building Tools for Microcomputers, provides system managers, planners, and potential expert system developers with a description of ESBTs for the microcomputer environment, identifying specific tool features and the capabilities they support.

#### **GAMS TO BECOME COMPONENT OF HPCC DISTRIBUTED INFORMATION SYSTEM**

NIST has been invited to participate in the High Performance Computing and Communications (HPCC) Distributed Information System project being organized by NASA. The system will integrate several software libraries and information systems, NIST's contribution being its Guide to Available Mathematical Software (GAMS) system. As part of this project, an X-window interface to the GAMS on-line software catalog will be developed, and data describing the net-lib software collection of Oak Ridge National Laboratories will be added to the GAMS database. The NIST scientist who leads the GAMS project, will also coordinate planning for ongoing user support for the integrated information system. A number of other organizations are also participating.

#### **INDUSTRY/NIST TO DEVELOP AXLE INSPECTION SENSOR**

An automobile manufacturer and NIST are working to produce a nondestructive evaluation (NDE) sensor for inspecting case hardened steel drive axles. Under a 2 year cooperative research and development agreement, an automobile industry engineer will collaborate with NIST scientists to develop electrical eddy current sensing technology to measure "case depth," or how deeply steel axles have been case hardened. Case hardening is a heat-treating process that carburizes metals by making the outer surface harder than the core. The NDE sensor will allow all axles to be tested, possibly replacing current destructive testing of a small fraction of axles produced. The cooperative effort is under the sponsorship of NIST's Office of Intelligent Processing of Materials, an agency-wide program for upgrading the quality of engineering materials and confirming their reliability in service. For information, contact Arnold Kahn, A163 Materials Building, NIST, Gaithersburg, MD 20899, 301/975-6146.

#### **COMPUTER SECURITY BBS USER'S GUIDE PUBLISHED**

The Computer Security Bulletin Board System User's Guide (IR4667), a 38-page manual offering step-by-step instructions for using the NIST Computer Security Division's electronic bulletin board system (BBS), is now available. The BBS offers federal agencies and the general public access to a variety of computer security information. Included are software reviews, publications, bibliographies, lists of organizations, an events calendar, and other government BBS numbers. To use the BBS, you need a modem and personal computer with communication software. Access the BBS by dialing 301/948-5717 (300-2400/8/N/1 or 300-2400/7/E/1) or 301/948-5140 (9600/8/N/1). If you can't access the BBS after verifying your communications hardware and software are operating correctly, call the voice line, 301/975-3359, and ask for the BBS system operator. The user's guide is for sale by the National Technical Information Service, Springfield, VA 22161. Order by PB 92-112390; price \$17.

#### **AMINO ACID, ION INTERACTIONS PROBED**

A new basic chemistry project is spinning off useful tools for clinical laboratories and may eventually shed light on how living cells communicate. The project's long-term goal is the development of a standard reference database on the thermodynamic properties of amino acids, polypeptides, and

proteins. A more immediate benefit is the creation of a set of Standard Reference Materials for pH buffer solutions. These are used by medical laboratories to assess the accuracy of blood chemistry analyses. Buffer solutions for pH 6.8 and 7.4 developed at NIST are more accurate than previous standards. Nearly ready is a third buffer of pH 7.8 that will complete the normal physiologic range for cells. The project next calls for determining the electrical conductivity and potential measurements of the essential amino acid glycine, as well as a simple polypeptide, glycylglycine. Completion of the long-term goal—an electrochemical database for amino acids, polypeptides, and proteins—could help biologists understand and model how nerve impulses travel throughout the body.

#### **FIRST COMPILATION OF HIGH $T_c$ PHASE DIAGRAMS**

Under a cooperative program between NIST and industry, the American Ceramic Society (ACerS) has published Phase Diagrams for High  $T_c$  Superconductors. The volume, which contains 231 ceramic phase diagrams, was compiled by a team of experts under a NIST chemist and an ACerS guest scientist. Chemical systems are divided into two parts: alkaline earth, rare earth, copper, and oxygen diagrams; and alkaline earth, bismuth/lead, and copper oxygen diagrams. Often described as “road maps,” the diagrams save individual producers from having to conduct research on the combination of two or more ceramic materials in various relationships and conditions. Data evaluations were conducted in the Phase Diagrams for Ceramists Data Center at NIST, one of 22 centers making up the National Standard Reference Data System. The volume is available for \$70 (\$62 for ACerS members) from the American Ceramic Society, 735 Ceramic Place, Westerville, OH 43081, 614/890-4700.

#### **BULLETIN SURVEYS ELECTRONICS/ELECTRICAL ABSTRACTS**

Measurement programs in semiconductor microelectronics, signals and systems, electrical systems, and electromagnetic interference are among those described in the Technical Progress Bulletin, available now from NIST. The Bulletin covers programs that provide national reference standards, measurement methods, supporting theory and data, and traceability to national standards. It features abstracts of papers and other published works arranged by topic (with phone numbers of contacts). Semiconductor topics covered include silicon materials, insulators and interfaces, integrated circuit

test structures, and photodetectors. Also in the Bulletin are sections on waveform, cryoelectronic, antenna, electromagnetic, and laser metrology. To receive the most recent issue, or to be placed on the Bulletin mailing list, write or call (stating professional affiliation or technical interest) EEEL, B358 Metrology Building, NIST, Gaithersburg, MD 20899, 301/975-2220.

#### **NIST—INDUSTRY COLLABORATION DEMONSTRATES POTENTIAL FOR USE OF GARNET IN HIGH-FREQUENCY MAGNETIC FIELD SENSORS**

A NIST scientist and a team of industry scientists have demonstrated that certain iron garnets possess a Faraday effect response at much higher frequencies than anticipated. The work grows out of measurements carried out and reported by NIST last year that showed the existence of a Faraday response for pure yttrium-iron-garnet (YIG) at frequencies as high as 700 MHz. The industry team had developed a theoretical model for domain wall movement in ferrimagnetic films and the relationship of this movement to Faraday frequency response. On learning of the NIST result, the industry team reported to NIST that the model suggested that other materials introduced into pure YIG should affect the frequency response. The industry team then arranged to provide NIST with selected iron garnet thick films for determination of their Faraday response with frequency. The results of NIST's transmission-line measurements showed reasonable agreement with the predictions of the theoretical model. The material properties that affect the frequency response are the saturation magnetization, the magneto-crystalline energy, and the damping constant associated with ferrimagnetic resonance. It appears that all of these may be adjusted (although not necessarily independently) by varying the composition of the garnet. The large Faraday rotation of the iron garnets makes them good candidates for compact, sensitive magnetic sensors. This work opens up a new range of applications for them. A publication describing this work is in preparation.

#### **NEW CALCULATIONS OF DEMAGNETIZING FACTORS PUBLISHED**

A former NIST guest researcher and two NIST scientists have completed a comprehensive study of the demagnetizing factors of circular cylinders, including a review of the literature. The results of this work have appeared in the July 1991 issue of the IEEE Transactions on Magnetics and constitute

the first across-the-board update of material published some 50 years ago. The subject is important to researchers and engineers concerned with ferromagnetic and ferroelectric materials. Demagnetizing factors are used to correct experimental magnetic measurements on finite-sized samples to give data characteristic of the actual material. The demagnetizing factors for cylinders depend on both the cylinder's aspect ratio and the material's magnetic susceptibility. In contrast to earlier specialized treatments, the NIST work covers the entire range of susceptibilities, including infinite susceptibility (for ferromagnetic materials), zero susceptibility (for paramagnetic and diamagnetic materials), and negative susceptibilities (applicable to superconductors). Factors are reported to four significant figures with an accuracy of 1 percent.

#### **NIST PUBLISHES CRITERIA FOR THE OPERATION OF SECONDARY CALIBRATION LABORATORIES FOR IONIZING RADIATION**

NIST recently published Special Publication 812, Criteria for the Operation of Federally-Owned Secondary Calibration Laboratories (Ionizing Radiation). These criteria, for laboratories that calibrate instrumentation used to measure ionizing radiation, may be used for accreditation of a particular laboratory. They were developed by a group of 47 representatives of federally owned laboratories that perform instrument calibrations, and represent a consensus of those experts with regard to the conditions necessary for the assurance of quality. NIST actively supports the development of secondary calibration laboratories for ionizing radiation measurements through the Office of Radiation Measurement. This office serves as the coordinator between the NIST technical staff and the NIST accrediting body, the National Voluntary Laboratory Accreditation Program. This program is expected to accredit about eight laboratories within the next 2 years in such areas as calibration of survey instruments and irradiation of personnel dosimeters with alpha, beta, gamma, and x rays. These laboratories can then provide a high-quality link between the physical measurement standards maintained by NIST and those who make routine measurements at the field level.

#### **NIST REFEREES AND PROVIDES STANDARDS FOR AN INTERNATIONAL INTERCOMPARISON OF ATMOSPHERIC RADON MEASUREMENTS**

An international intercomparison of instruments used to measure trace atmospheric concentrations

of radon was recently conducted at the Bermuda Biological Research Station. Measurements of radon in remote marine environments are used to obtain information on the temporal and spatial distributions which are in turn used to test and validate global models that simulate the transport and removal of trace atmospheric species. Unlike other chemical species, radon is an excellent tracer for such studies because it has a well-characterized source (large land masses) and only one principal "sink" (radioactive decay). NIST's radioactivity group participated and served as the referee for the intercomparison, and was responsible for providing standardized additions of radon concentration to the sampling tower used by the various participants for simultaneous measurements. The intercomparison included radon activity concentrations ranging from less than 50 atoms per L (at typical ambient levels) to over several hundred thousand atoms per L (0.001 Bq/L to 0.4 Bq/L). The participants were the U.S. DOE Environmental Measurements Laboratory; Centre des Faibles Radioactivités, Laboratoire CARS-CEA, France; the Australian Nuclear Science and Technology Organization; and Drexel University (U.S.A.). This exercise was the first such intercomparison of instruments used in different worldwide locations and will provide a common reference and intercalibration for data obtained from various world locations.

#### **TECHNOLOGY TRANSFER PROGRAM BETWEEN NIST AND SEMATECH YIELDS NEW STANDARDS AND IMPROVES U.S. COMPETITIVENESS**

NIST recently completed a joint development contract with Sematech to establish calibration procedures for ultraviolet (uv) light intensity measurements. NIST now provides a service for calibrating I-line (the 365 nm mercury line) radiometers used as detectors in photolithography systems. A direct benefit of this program was to demonstrate that the U.S.-manufactured, GCA I-line system, performs equivalently to its competitors. GCA can now offer its customers better control of their semiconductor production as a result of uv measurements that are traceable to a NIST standard. The weaknesses and strengths of I-line radiometers and the techniques used to calibrate them are identified in the Sematech technology transfer publication #91040516A-ENG.

**NEW EDDY CURRENT INVERSION THEORY**

A NIST scientist, in collaboration with the University of Surrey Physics Department, U.K., has developed a general theory of flaw reconstruction from eddy-current measurements. Based on this theory, multifrequency and variable probe-position impedance data can be processed to determine the three-dimensional geometry of discrete flaws—cracks or voids—in metals. The theory also permits the determination of an unknown continuous distribution of electrical conductivity. Thus far, reconstructions based on simulated multifrequency impedance data have verified the theory for a layered conductor, in which the thicknesses and conductivities of the individual layers were successfully predicted. Other potential applications of the inversion methodology include the nondestructive characterization of composite materials and the determination of the thickness of metallic coatings.

**FLOW THROUGH POROUS MEDIA**

NIST scientists have developed a method for measuring the permeabilities of fiber preforms which minimizes edge effects and maximizes the accuracy of flow and pressure measurements. The permeability to resin flow of fiber preforms, the reinforcement fabrics of polymer composite parts, is needed to accurately model mold filling in resin transfer molding. The NIST method uses saturated fabrics in one-dimensional flow geometries, and data are collected for flow in at least three directions in the case of an anisotropic fabric. From such measurements the in-plane permeability tensor is determined and flow in any in-plane direction through the fabric can be calculated. This method is currently being extended to measure the complete three-dimensional permeability tensor.

Collaborative work with a private company was undertaken to compare permeability data obtained by the NIST method with values measured in unsaturated radial flow experiments. The excellent agreement between the NIST predictions of the shape and progress of elliptical flow fronts in radial flow experiments and the experimental observations at the company indicated that the radial and one-dimensional flow experiments are geometrically consistent, and, therefore, can be combined in characterization studies to maximize efficiency.

**CIB WORKSHOP ON FIRE MODEL VERIFICATION, SELECTION, AND ACCEPTANCE HELD AT NIST**

The Committee on Fire (W14) of the International Council for Building Research Studies and Docu-

mentation (CIB) recently held a Workshop on Fire Model Verification, Selection, and Acceptance at NIST.

The workshop was designed to provide strategic guidance to the research community on knowledge needed for the verification of fire models and their international acceptance for use in fire safety engineering. The sessions covered: model quality and validity, supporting infrastructure needed, guidance for selection and use of models, and criteria and strategy for model acceptance.

The workshop attendees agreed that guide documents on model validation and on model documentation developed by ASTM should be reviewed by CIB for submission to ISO as bases for international standards. They also recognized the need for an internationally accepted method for organizing input data and large-scale test data for convenient use by fire model developers and users. The method should be developed for electronic distribution. The fire data management system conceived in the NIST fire program is a candidate. It was agreed that CIB should develop a 5 year coordinated program of research on the validation and use of fire models.

**NORTH AMERICAN INTEGRATED SERVICES DIGITAL NETWORK (ISDN) USERS' FORUM (NIU-FORUM) RESULTS PUBLISHED**

Two new publications document the work of the NIU-Forum, a NIST/industry collaboration established in 1988 to create a strong user voice in the implementation of ISDN technology. NIST Special Publication 500-194, ISDN Conformance Testing, Layer 1 – Physical Layer, Part 1 – Basic Rate S/T Interface, User Side, describes a set of test specifications, developed by NIU-Forum members, which test conformance of Terminal Equipment and Network Termination (NTs) to the ISDN Physical Layer at the S/T reference point, as defined in American National Standard (ANS) T1.605-1989. NIST Special Publication 500-195, North American ISDN Users' Forum Agreements on Integrated Services Digital Network, compiles the existing NIU-Forum agreements as of November 1990.

**GLOSSARY OF COMPUTER SECURITY TERMINOLOGY PUBLISHED**

NISTIR 4659, Glossary of Computer Security Terminology, presents a collection of terms and definitions used by various federal departments and agencies in their policies, standards, and other publications. Developed under the auspices of the National Security Telecommunications and Information Systems Security Committee and published

by NIST as part of its efforts to disseminate federally sponsored work, the document provides multiple definitions to reflect the variations in use of these frequently encountered computer and communications security terms among the federal community.

#### **SMALLEST ANTENNAS IMITATE INSECT COMMUNICATION**

Using tools developed for fabricating electronic integrated circuits, NIST scientists have produced microantennas the size of a grain of sand and only 60  $\mu\text{m}$  across (about the diameter of a human hair). At this tiny size, these "world's smallest" antennas can capture the extremely short (about 3 to 30  $\mu\text{m}$ ) wavelengths of infrared radiation. Their development paves the way for novel infrared detectors that rely on antennas to "see" images of heat radiating from all warm objects such as people, animals, and buildings. Such detectors have many applications, including satellite observation of Earth, astronomy, medicine, and national defense. There is evidence that insects evolved microantennas, similar to the NIST devices, to enhance their infrared pickup, allow them to see in darkness, and give them a survival advantage. The NIST work proves that such tiny insect structures can function efficiently for infrared wavelengths.

#### **NEW OFFICE TO SPEED ROCKY MOUNTAIN TECH TRANSFER**

To coordinate and intensify the commercialization of government-developed technology to industry in the Rocky Mountain region, NIST has established an Office of Research and Technology Applications (ORTA) at the U.S. Commerce Department's Boulder, CO Laboratories. The office will support the technology transfer efforts of scientists and engineers at the three laboratories—NIST, the National Oceanic and Atmospheric Administration's Environmental Research Laboratories (NOAA/ERL), and the National Telecommunications and Information Administration (NTIA)—by coordinating common on-site services, providing training in commercialization procedures, helping create Cooperative Research and Development Agreements (CRDAs), licensing federal patents, and improving dissemination of research results to the private sector.

#### **NEW PUBLICATION ISSUED ON SECURITY IN ISDN**

In this decade, Integrated Services Digital Network (ISDN) standards will provide worldwide digital communications service and play a key role in the transition to electronic documents and business transactions. Government and businesses are increasingly concerned with security in ISDN. Security in ISDN (NIST Special Publication 500-189), covers the standards needed to implement user security. ISDN security standards should take advantage of, and be compatible with, emerging standards for Open Systems Interconnection security, including confidentiality, access control, authentication, data integrity, and nonrepudiation. The challenge of ISDN security is to extend these concepts to all ISDN applications, including voice use of the public network. The 76-page publication provides a broad discussion of user security needs and suggests possible solutions. Available from the National Technical Information Service, Springfield, VA 22161 for \$19 prepaid. Order by PB 92-116391.

#### **CASE STUDY ON SOFTWARE RE-ENGINEERING**

Software re-engineering involves the use of existing software and documentation to specify requirements, design, documentation, and production of software for a new computing platform. Software Reengineering: A Case Study and Lessons Learned (NIST Special Publication 500-193) targets managers and technical personnel in government and industry who need to understand concepts and issues of software re-engineering, the use of Computer-Aided Software Engineering (CASE) tools in the re-engineering process, and the application of this technology to organizational problems. A case study conducted by NIST and the Internal Revenue Service indicates that software re-engineering can be a cost-effective, viable solution for extending the lifetime of an application system. Technical information on the 39-page publication is available from Mary K. Ruhl at 301/975-2983. The publication is for sale by the National Technical Information Service, Springfield, VA 2161 for \$17 (hard copy) and \$9 (microfiche) prepaid. Order by PB 92-116417/AS.



### **MAGNETIC FIELD FACILITIES IN JAPAN EVALUATED**

Japanese high magnetic field facilities for research on superconducting materials are capable of producing fields (both direct current and pulsed) comparable to the highest in the world, says a NIST researcher in a study prepared under the Japanese Technical Literature Act of 1986 (P.L. 99-382). Further, a concerted effort by Japan will result in a new magnetic facility capable of creating the world's highest dc field, 40 T, by 1993 (current highest is the U.S. limit at 31.8 T). The United States will not reach 45 T until new facilities are completed by 1995 or later, so research in this area must currently be performed in either Japan or Europe. The NIST report says most research on superconducting materials does not require the highest magnetic fields. However, critical properties such as current density and temperature must be perfected at such levels before promising new materials can be used. High Magnetic Field Facilities in Japan Related to Superconductivity Research (NISTIR 4593), is available for \$17 prepaid from the National Technical Information Service, Springfield, VA 22161. Order by PB 91-240762.

### **TRAPPED ION EXPERIMENTS HIGHLIGHTED**

Researchers in the field of trapped and stored atoms and ions will be interested in a new paper from the NIST ion storage group in Boulder, CO. The paper summarizes recent work in developing techniques for high-resolution spectroscopy using stored ions. Topics covered in the paper include beryllium hyperfine pressure shift, linear Paul traps, Penning trap density limitations, theory of Sisyphus cooling for a bound atom, observation of "atomic projection" noise, and subharmonic excitation of a single electron. For a copy of paper 49-91, Recent Experiments on Trapped Ions at the National Institute of Standards and Technology, contact Jo Emery, Div. 104, NIST, Boulder, CO 80303, 303/497-3237.

### **"MEETING THE CHALLENGE" NOW AVAILABLE ON VHS**

A new videotape describing how NIST helps strengthen U.S. industry's competitiveness, advance science, and improve safety, health, and the environment was recently released. The 11 minute tape, "Meeting the Challenge," highlights research in biotechnology, precision

measurement of atoms, intelligent processing of materials, automated manufacturing, the Integrated Services Digital Network, and the Malcolm Baldrige National Quality Award. Also featured are cooperative programs with the Ray Watson Co., Du Pont, and Hewlett-Packard. VHS copies are \$12 (shipping included) and may be purchased from Video Transfer, Inc., 5709-B Arundel Ave., Rockville, MD 20852, 301/881-0270.

### **HIGH-PERFORMANCE COMPUTING ACT OF 1991 (S. 272) BECOMES LAW**

On Dec. 9, the President signed into law S. 272, the High-Performance Computing Act of 1991—P.L. 102-194. NIST's responsibilities under the act include: developing and proposing standards and guidelines and developing measurement techniques and test methods for the interoperability of high-performance computing systems in networks and for common user interfaces to systems; developing benchmark tests and standards for high-performance computing and software; and developing and proposing standards and guidelines for assuring cost-effective security and privacy for sensitive information in federal computer systems.

### **NIST WORK PROMPTS INCREASED INTEREST IN ADVANCED PARTIAL DISCHARGE MEASUREMENT SYSTEMS AS DIAGNOSTIC TOOLS**

The electric power industry is becoming increasingly interested in applying to practical diagnostic issues the results of the research on partial discharge measurements carried out by NIST scientists. It recently has sought sensors for physical parameters to be incorporated in its largest, most expensive high-voltage transformers to be able to operate the resulting "smart" devices as close to their limits as possible for the sake of efficiency. Conventional sensors develop limited data useful for predicting failure. The NIST research has demonstrated that partial discharge measurement systems can provide data for failure prediction, and the electric power industry is renewing its interest in these systems. A major contribution of the NIST work has been to uncover the basis for the nonstationary behavior of partial discharge phenomena, which frustrated previous attempts at reliable pattern recognition using conventional pulse-height analysis techniques.

### PROTEIN MAPPING TECHNIQUES ADVANCE CANCER RESEARCH

A method based on two-dimensional electrophoresis and computerized image processing has been developed to map and characterize subtle changes in the protein composition of cancer cells when they are treated with chemotherapy drugs. This research was featured in a recent issue of Genetic Engineering News, one of the most widely read biotechnology news magazines. NIST scientists collaborated with researchers at the John Wayne Cancer Institute at St. John's Hospital in Santa Monica, CA, in this research, which is being used to identify specific proteins associated with the disease state. When the protein maps of untreated cells of skin cancer (melanoma) patients were compared with the maps of cells treated with chemotherapy drugs (e.g., interferon or tumor necrosis factor), it was discovered that the cells slowed down or stopped production of certain proteins and increased or began making other proteins in response to treatment. Attempts are being made to correlate the genetic expression of these proteins with the tumor gene products and the tumor suppressor gene products. This approach will prove valuable in monitoring the effects of drugs on tumor cells as well as providing insight into the molecular mechanisms of tumor growth and suppression.

### ULTRACOLD ATOMIC COLLISIONS

Collisions of laser cooled and trapped atoms exhibit new and unusual effects at temperatures below 1 mK. Recent studies at NIST show that these collisions can be modeled by considering the relative motion of two atoms in a laser field and allowing this energy to dissipate by spontaneous photon emission. The equations of motion, called the optical Bloch equations and widely used in quantum optics, are normally not used to describe collisions. This theoretical formulation offers new insight into the novel mechanisms of ultracold collisions, treats intense laser modification of the collision dynamics, and provides a predictive tool for analyzing experiments. Good agreement is found between theory and current experiments on both Cs and metastable He traps. It is expected that predictions for other traps will soon be tested by experiments at NIST and other laboratories.

### A MULTINATIONAL VIEW OF THE ACTIVE SUN

On Aug. 30, a major x-ray imaging and spectroscopic spacecraft was launched from the Kagoshima

Space Center in Sagami-hara, Japan. As reported Nov. 8 in Science, the satellite, now dubbed Yohkoh, has begun sending back spectacular pictures of solar activity viewed with unprecedented angular resolution and spectroscopic refinement. Developed by the Japanese space science agency, the spacecraft's principal instrumentation is a multinational project involving U.S., U.K., and Japanese research organizations.

Spectacular early results from the mission include remarkable high-resolution spectra being recorded and sent to Earth from a group of four Bragg crystal spectrometers (BCS) on Yokoh. These instruments, three trained on the He-like resonance lines of S, Ca, and Fe and one on H-like Fe, were developed jointly by the Naval Research Laboratory and NIST in collaboration with the Rutherford Appleton Research Laboratory and Imperial College in the United Kingdom.

The BCS instrument required both improved sensitivity and improved resolution in a package severely constrained in volume, mass, footprint, and power consumption in comparison with previous NASA missions. The overall design of BCS was a joint undertaking, with NIST responsible for the design, fabrication, testing, and alignment of the four large,  $4 \times 18$  cm, germanium diffraction crystals, each bent to a particular radius of curvature between 5 and 15 m. The technology needed, the result of more than 2 decades of development for a wide range of applications, was fully exploited in preparing the crystals now in orbit.

Results already in hand indicate that the efforts were fully successful. Both the spectroscopic detail resolved and the instrumental sensitivity are in accord with expectations. Of particular note in this regard is that there is already evidence of rapid outward motion of flare material in the period of time before the flare manifests itself to the telescope.

### QUALITY CONTROL IN RADIATION THERAPY

NIST and the U.S. Nuclear Regulatory Commission recently co-sponsored a workshop at NIST to examine calibration issues for the high-dose-rate (HDR) iridium-192 radioactive sources used in cancer therapy. Over 100 of these computer-controller source-insertion devices are now used in the United States for the treatment of approximately 6,000 patients per year. A national strategy is needed for calibrating these sources to allow uniform specification of source strength by source manufacturers, instrument manufacturers,

secondary calibration laboratories, and hospital medical physicists. The sources have activities more than 100 times higher than the low-dose-rate iridium-192 seeds for which NIST offers calibrations. The goal of the workshop was to define the requirements for NIST and the secondary calibration laboratories, and to explore the standardization methods and transfer instruments appropriate to each level. Based on discussions held at the workshop, NIST will begin to develop an appropriate national primary dosimetry standard. The workshop provided the medical physics community, the health-care industry, and regulators with a snapshot of quality control and standards-related issues in HDR iridium-192 cancer therapy.

#### **MERGED-BEAMS TECHNIQUE FOR ABSOLUTE ELECTRON-ION EXCITATION MEASUREMENTS DEMONSTRATED**

The combination of a merged-beams and an electron-energy-loss technique has permitted ground-breaking absolute measurements of a cross section for electron-impact excitation of a multiply-charged atomic ion. Highly charged atomic ions are pervasive and critical elements in high-temperature plasmas (fusion, astrophysical, laser, and others). Their structure, dynamics, and interactions with other particles are, despite the crying need for data as well as fundamental understanding, generally not well known. Experimental information on electron-impact excitation of multiply-charged ions is particularly scarce—almost all past measurements involved singly-charged ions and a very restricted set of transitions for which fluorescence from excited states could be used as the detector. This new collisions technology, combined with the availability of abundant ions from advanced ion sources, permits greatly enhanced signals (merged rather than crossed beams) and detection efficiencies (all electrons involved rather than just some photons) compared with that attainable with traditional ion sources and crossed-beams collision geometries. The first measurements that demonstrated the power of this new technique involved the third ionic stage of silicon, but an entirely new spectrum of measurements has now been proven feasible. A key element in the new technique is a real-time charged-particle beam probe that can be used both as a beam diagnostic and to quantitatively determine the beam density distribution in all three dimensions.

#### **NEW PUBLICATION FOCUSES ON COMPUTER SECURITY INCIDENT RESPONSE**

Increased threats to computer security have prompted government agencies and industry organizations to augment their computer security efforts. NIST Special Publication 800-3, Establishing a Computer Security Incident Response Capability (CSIRC), provides advice and assistance on initiating an efficient and timely response to computer security-related incidents such as computer viruses, unauthorized user activity, and serious software vulnerabilities. The guide discusses some of the considerations in establishing a CSIRC and the organizational, technical, and legal issues connected with a CSIRC operation. Efficient and cost-effective, a CSIRC is a proactive approach to computer security, one that combines reactive capabilities with active steps to prevent future incidents.

#### **NIST COLLABORATION ON FRICTION CHARACTERIZATION OF ULTRA-LOW SPEED TURNING MACHINES**

Two mechanical engineers from a major U.S. university recently completed a 3 month research project at NIST in collaboration with a NIST statistician. The project goal was to improve the precision of high-performance grinding where a machining defect called sub-surface damage is a major problem. The basic hypothesis is that this damage occurs due to impact type chip removal in the machining process. Such impact chip removal is avoided by machining in the ductile regime, which translates to a very slow and well-regulated speed control problem. Such low speeds accentuate the effect of friction and its unpredictable nature. To study this problem, off-line statistically designed experiments involving factors affecting friction were conducted. The data collected were analyzed to understand the friction characterizations and develop appropriate model structures for on-line control. Details of this collaborative research will appear as a NIST internal report.

#### **A CATALYST PACKAGE FOR LUBRICANT OXIDATION (ASTM SEQUENCE IIIE ENGINE TEST)**

The Standard Reference Materials Program announces the availability of RM 8501, a Catalyst Package for Lubricant Oxidation. The material is intended for use in a modified thin-film uptake test developed for use with oils for the ASTM Sequence IIIE Engine Test.

The thin-film oxygen uptake test identified in ASTM D4742 was originally developed to evaluate

the oxidation stability of automotive crankcase lubricants under conditions similar to ASTM engine sequence 111D test. The test used fuel fractions and mixed metal catalysts to simulate the chemical environment in an operating automotive engine. Recently, ASTM Sequence 111E test was developed to replace the 111D test. The 111E test defines a new oil category having improved performance and requires an increased oxidation severity. This is achieved by using a smaller oil charge and increased blow-by to oil charge ratio.

The oxidation induction times for seven IIIE oils were determined by both the modified thin-film oxygen uptake test and differential scanning calorimetry using RM 8501. The test conditions for the correlation between the two measurements are given in the Report of Investigation.

The RM includes five ampoules each of four components: an oxidized/nitrated fuel fraction; a nitroparaffin model compound; a metal naphthenates mixture containing lead, iron manganese, and tin in a 20:2:1:1 weight ratio; and distilled water. Each is contained in a sealed ampoule, which should be thoroughly shaken before opening and sampled immediately after opening in order to maintain the RM integrity.

#### **REFERENCE MATERIALS 8589 AND 8590— FLUID CRACKING CATALYSTS (8589) AND HIGH SULFUR GAS OIL FEED (8590)**

The Standard Reference Materials Program announces the availability of two reference materials (RMs), 8589 and 8590, intended for use in determining the activity of Fluid Cracking Catalysts (FCC) as specified in the American Society for Testing and Materials Microactivity Test D3907-87. RM 8589 consists of six 50 g units of equilibrium FCCs, one each of RR1 through RR6, while RM 8590 consists of 946 mL of the High Sulfur Gas Oil Feed (Amoco Oil No. FCC 893).

These RMs are intended for use primarily by the petroleum refining industry and catalyst suppliers to this industry. They were prepared and characterized through a cooperative program between NIST and the ASTM Committee D32 on Catalysts. The six FCCs comprising RM 8589 are characterized for the weight percent conversion of gas oil, RM 8590, in a microactivity unit. Results given are the consensus values from an interlaboratory study after modification for nonuniform data according to ASTM Standard Practice E 691.

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## **Calibration Services**

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### **NEW HUMIDITY MEASUREMENTS PUBLICATION AVAILABLE**

The National Weather Service, the semiconductor industry, and food processors all keep a watchful eye on humidity with a variety of sophisticated instruments. When these instruments need calibration, industry and government scientists turn to a specially designed lab at NIST that compares the instruments' performance against the most accurate humidity standards available. A new 61-page publication describing NIST calibration services for humidity measurements has been compiled. The new document is a combined and condensed version of earlier reports on NIST's primary and secondary standards for humidity measurement. The two-part document covers NIST's standard hygrometer and two-pressure humidity generator. NIST Calibration Services for Humidity Measurement is available from the National Technical Information Service, Springfield, VA 22161. Order by PB 92-112499; price is \$19 in print or \$9 on microfiche.

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## **Standard Reference Materials**

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### **STANDARD REFERENCE MATERIAL 1414— LEAD-SILICA GLASS HIGH-TEMPERATURE RESISTIVITY**

The Standard Reference Materials Program announces the availability of SRM 1414, Lead-Silica Glass for High-Temperature Resistivity. SRM 1414 is intended for use in glass resistivity measurements. The SRM is a lead-silica glass (4×4×12 cm bar) certified for resistivity at a series of temperatures in the molten range of 950-1300 °C. Additional information is also given on the glass composition, refractive index, and dispersion.

### **STANDARD REFERENCE MATERIAL 2695— FLUORIDE IN VEGETATION**

The Standard Reference Materials Program announces the availability of SRM 2695, Fluoride in Vegetation (timothy grass). This SRM is intended for use in monitoring fluoride in vegetation

used as cattle forage, for which there are annual, bimonthly, and monthly regulatory limits in the range of 40-80 parts per million (ppm). Animals normally ingest small amounts of fluoride in their rations with no harmful effects. However, excessive fluoride ingestion can cause specific dental and skeletal lesions, and in severe cases, adversely influence the productive performance of domestic animals. Uncontaminated plant material typically contains less than 5 ppm.

The SRM is supplied as 25 g each of a low and high level sample. The low-level concentration of 64.0 ppm is in the range of the regulatory limits, which varies somewhat between states, while the high-level concentration of 277 ppm exceeds all regulatory limits.

Certification measurements were made using a number of methods, including the Association of Official Analytical Chemists (AOAC) and Intersociety method for the semi-automated determination of fluoride based on calorimetric alizarin measurement following fusion and microdistillation.

#### **STANDARD REFERENCE MATERIAL 885—REFINED COPPER**

The Standard Reference Materials Program announces the availability of SRM 885, Refined Copper. The intended use of this SRM is for calibration of instruments and the evaluation of methods used in determining sulfur and oxygen in pure copper or related materials. SRM 885 will be used primarily by copper producers employing a continuous casting process in producing high purity copper rod or wire products. It is certified for sulfur and oxygen contents of 0.0018 percent and 0.013 percent, respectively, and has been analyzed for trace element impurities such as antimony, arsenic, bismuth, iron, lead, nickel, silver, tin and zinc.

The SRM is in the form of pins approximately 13 mm long and 3 mm in diameter, having a mass just under 1 g.

#### **AROMATIC HYDROCARBONS IN TOLUENE (NOMINAL CONCENTRATION 60 µg/mL)**

The Standard Reference Materials Program announces the availability of SRM 2260, Aromatic Hydrocarbons in Toluene. The SRM is intended primarily for use in calibrating chromatographic instrumentation and for use in evaluating analytical methods used to determine aromatic hydrocarbons

(AHs). The SRM consists of five 2 mL ampoules, each containing approximately 1.2 mL of the AHs in toluene solution. Because of the volatility of toluene, certified values are not applicable to material, unless analysis is initiated immediately (under 5 min) after opening the ampoule.

SRM 2260 is certified for the actual concentrations of 23 AHs, all present in the toluene at a nominal concentration of 60 µg/mL. The concentration of one additional AH is not certified but is given for information. The actual concentrations were determined both gravimetrically in preparing the solution and chromatographically on the prepared solution.

#### **TWO NEW SRMs FOR OPIATES IN URINE CERTIFIED**

NIST has an ongoing program, in cooperation with the College of American Pathologists, to provide the drugs-of-abuse testing community with urine-based reference materials. Scientists at NIST recently have completed work on two new SRMs for drugs of abuse in urine. SRM 2381 is a freeze-dried human urine material with certified concentrations of free morphine and codeine at three levels. Certification was accomplished by use of two independent methods. One was a gas chromatography/mass spectrometry (GC/MS) procedure, similar to the procedures used in drug testing laboratories to confirm and quantify these analytes in samples that test positive in preliminary screening analyses. The other involved liquid chromatography/mass spectrometry (LC/MS) with a different sample preparation procedure. The certified concentrations bracket the cutoff concentration level set by the National Institute of Drug Abuse for determining both morphine and codeine abuse and thus permit laboratories to validate the accuracy of their methods in this critical concentration range.

The second material, SRM 2382, has three certified levels of morphine glucuronide in freeze-dried human urine. Much of the morphine excreted by opiate users is in the form of the glucuronide. Laboratories testing urine specimens for opiates must release the morphine from the morphine glucuronide prior to accurately measuring the morphine present. The quantitative release of morphine has been identified as a major problem area in accurate drug analysis. This SRM will allow laboratories to test their methods for releasing the morphine on samples with known concentrations. Certification of SRM 2382 required the use of a

different procedure for releasing morphine for each of the analytical techniques used for the measurements. Enzymatic hydrolysis was used with the GC/MS method and acid hydrolysis was used with LC/MS. Careful studies at NIST found the two hydrolysis procedures to provide comparable results.

#### **STANDARD REFERENCE MATERIAL 1048, CUP FURNACE SMOKE TOXICITY STANDARD**

The Standard Reference Materials Program announces the availability of SRM 1048, Cup Furnace Smoke Toxicity Method Standard. The SRM is intended for use in calibrating the NIST Cup Furnace Smoke Toxicity Method for assessing the acute inhalation toxicity of combustion products. The SRM consists of eight sheets of acrylonitrile-butadiene-styrene (ABS) copolymer, each approximately 254 mm square and 0.76 mm thick. The quantity is sufficient for calibration of the test method four times.

Certified values for  $LC_{50}$  and N-gas in flaming and nonflaming modes are provided at 30 min and 30 min plus 14 d post exposure periods. The values are based on three separate series of tests and statistical evaluation of the resultant data.

#### **STANDARD REFERENCE MATERIALS 1271 AND 2171 LOW-ALLOY STEEL (Ni-Cr-Cu-Mo) (HSLA 100)**

The Standard Reference Materials Program announces the availability of SRMs 1271 and 2171, Low-Alloy Steel issued in both disk and chip forms. The steel is identified as HSLA 100 (Ni-Cr-Cu-Mo) and is primarily intended for use in optical emission and x-ray spectrometric analyses (disk) or in chemical methods (chip). SRM 1271 is issued in the form of a disk approximately 35 mm in diameter by 19 mm thick, while SRM 2171 is issued as 150 g of chips, sized between 0.50 and 1.18 mm (or between 16 and 35 mesh).

Certification was performed in cooperation with ASTM. In addition to Ni, Cr, Cu, and Mo, the SRMs are certified for C, Mn, P, S, Si, V, Al and Nb.

#### **STANDARD REFERENCE MATERIAL 2193, CALCIUM CARBONATE pH STANDARD**

The Standard Reference Materials Program announces the availability of SRM 2193, Calcium Carbonate pH Standard. This commercially available calcium carbonate, selected specifically for its extremely low level of metal impurities, is certified only with respect to pH values and not for compo-

sition. The SRM is supplied as a 30 g unit of finely powdered material. It is intended for calibration of pH measuring systems at pHs above 11.0.

The SRM is used to prepare a freshly filtered saturated solution (0.0202 molal) of calcium hydroxide as instructed on the certificate. The pHs of the resulting solution are certified at 12 temperatures from 0 to 50 °C, based on EMF measurements of cells without liquid junction, using hydrogen gas and AgCl/Ag electrodes. Two-point calibration is recommended for high alkalinity measurements and is accomplished using SRM 2193 in conjunction with SRM 187 (borax).

#### **STANDARD REFERENCE MATERIALS 862 AND 1242, HIGH-TEMPERATURE ALLOY L 605**

The Standard Reference Materials Program announces the availability of SRMs 862 and 1242, the chip and disk forms of High-Temperature Alloy L 605. The chips are intended primarily for use in chemical methods of analysis, while the disks are for use in optical emission and x-ray spectrometric methods. SRM 862 is issued as a unit of 100 g of chips sized between 0.35 and 0.85 mm (or between 46 and 20 mesh). SRM 1242 is issued as a disk approximately 35 mm in diameter and 19 mm thick.

SRMs 862 and 1242 are certified for 13 elements: the primary constituents Co, Cr, W, Ni, Fe, and Mn, and the trace constituents C, P, S, Si, Cu, V, and N. Certification was performed in cooperation with ASTM.

#### **STANDARD REFERENCE MATERIAL 1976, INSTRUMENT SENSITIVITY STANDARD FOR X-RAY POWDER DIFFRACTION**

The Standard Reference Materials Program announces the availability of SRM 1976 for use in calibration of powder x-ray diffraction intensity as a function of 2 angle (instrument sensitivity) and to provide comparability of measurements between laboratories. The SRM consists of a sintered high-purity alumina plate approximately 45 mm on a side and 1.6 mm thick. The material was selected for consistency of microstructure.

The SRM is certified for the absolute variation of intensity of the [104] reflection, 12 relative intensities determined throughout the 2 range of x-ray diffraction goniometers, and the lattice parameters. Proper use of the SRM requires measurement of test equipment intensities according to one of the two procedures used for certification of the SRM.