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

NIST CHARACTERIZES NOAA INSTRUMENT FOR MEASURING GLOBAL CHLOROPHYLL CONCENTRATIONS

In 2002, a team of physicists from NIST completed characterization of, and resolved calibration issues concerning, the Marine Optical Buoy (MOBY). MOBY, a NOAA instrument developed with the support of NASA, is the centerpiece of the primary ocean measurement site for vicarious calibration of satellite ocean-color sensors. MOBY is deployed in the Pacific Ocean off of Lanai, Hawaii. It is an essential instrument in the science of quantifying the global carbon cycle for the U.S. Global Change Research Program, concerned primarily with chlorophyll concentrations in the oceans as measured remotely by radiometric techniques.

As a calibration reference site, MOBY is a key element in the international effort to develop a global, multiyear time series of consistently calibrated ocean-color products using data from a wide variety of independent satellite sensors. Since late 1996, normalized water-leaving radiances, determined from the array of radiometric sensors attached to MOBY, are the primary basis for the on-orbit vicarious calibrations of the American Sea-viewing Wide Field-of-view Sensor (SeaWiFS), the American Moderate Resolution Imaging Spectrometer (MODIS), the Japanese Ocean Color and Temperature Sensor (OCTS), the French Polarization Detection Environmental Radiometer (POLDER), and the German Modular Optoelectronic Scanner on the Indian Research Satellite (IRS1-MOS).

NIST physicists performed detailed radiometric characterizations of the MOBY sensor system, both in the laboratory in Gaithersburg and at the MOBY Operations Facility in Honolulu. The studies were made possible by the NIST facility for spectral irradiance and radiance responsivity calibrations using uniform sources (SIRCUS). SIRCUS uses broadly tunable, narrow-band lasers to produce wide-area illumination. It provides the unique ability to measure spectral channel cross talk due to stray-light effects. To complete the work on MOBY in Honolulu, it was necessary to develop and implement a portable version of SIRCUS.

As a result of the NIST work, a correction algorithm was applied to MOBY system responses. These results were used to revise the calibration of SeaWiFS and MODIS, and will result in more accurate values and additional constraints on the atmospheric corrections for all ocean color satellites that use MOBY data. Refinements and improvements to the correction algorithm are in progress. Ultimately, the data will affect the models used to interpret ocean-color measurements in terms of biological factors (e.g., chlorophyll concentrations). The duration and magnitude of phytoplankton primary productivity impacts carbon fixation, carbon export, and air-sea carbon flux, so this work results in more accurate estimates of the oceanic net carbon biological uptake.

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NIST-LED INTERNATIONAL COLLABORATION RESULTS IN IMPROVED MEASUREMENT TECHNOLOGY FOR LIGHT STABLE ISOTOPES RELEVANT TO CLIMATE CHANGE RESEARCH

Two manuscripts recently have been published in *Rapid Communications in Mass Spectrometry* [RCM **17**, 771-776 (2003) and RCM **17**, 777-782 (2003)] that detail an international collaboration to identify, understand at a fundamental level, and correct measurement biases manifested in gas isotope ratio mass spectro-

meters. These biases arise from memory effects in ion sources and affect the reliability and comparability of carbon-13 and oxygen-18 measurements used in studies requiring high interlaboratory reproducibility, including research relevant to climate change. In this regard, measurements of light stable isotopes in carbon dioxide, methane, and other atmospheric trace gases provide a unique means to better understand their sources, fates, and contributions in biogeochemical cycles. This collaboration already has resulted in the tangible improvement of the measurement tools used by hundreds of international research groups, and improved the value assignments of isotope reference materials distributed by NIST and the International Atomic Energy Agency (IAEA).

The first manuscript details an intercomparison exercise that was successful in providing extensive measurements of sufficient quality needed to construct mechanistic models of memory effects in the mass spectrometers. The models were consistent with the presence of two instrumental memory sources—one short-lived (10 s to 20 s) and the other long-lived (6 min to 10 min)—that could not be compensated accurately by normal background corrections. Observed biases were substantial and dependent upon several operational parameters. The results, originally presented in December 1995 to the IAEA Consultants' Meeting for Light Stable Isotope Reference Materials in Vienna, Austria, initiated research and development activities to address these effects at several other organizations in collaboration with NIST.

The second manuscript describes the results of a collaboration with an instrument manufacturer, to test new focusing plates and slits in the NIST ion source and in an identical instrument at the Max-Planck-Institute for Chemistry in Mainz, Germany. The new ion source materials were designed and engineered to minimize the specific memory effects previously identified, and historical data from the NIST instrument provided the benchmarks needed to compare precisely and document the change in observed performance. Biases in carbon-13 and oxygen-18 measurements were decreased by up to a factor of five, which enabled up to a 50 % reduction in the uncertainty of reference material value assignments. The newly engineered ion source is incorporated in the isotope ratio instruments, which has benefited the research of greater than 550 research groups worldwide. This manuscript reveals the technology to a wider audience of instrument manufacturers and offers several practical recommendations to the measurement communities regarding the minimization of the biasing effects.

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NIST DELIVERS RADAR CROSS SECTION STANDARD ARTIFACTS TO INDUSTRY

As part of a national effort to standardize radar cross section (RCS) measurements, NIST delivered a set of standard precision cylinders to a private company in McKinney, Texas, in December 2002. The calibration artifacts will be used to characterize the company's RCS measurement range from 2 GHz to 18 GHz. The diameters of the cylinders range from 3.75 in to 9.00 in, and their heights range from 1.75 in to 4.2 in. All the dimensional tolerances were determined to be ± 0.001 in. This cylinder set is the first in a series of precision artifacts that can be manufactured at NIST to support the RCS community's cooperative standards research program, with the objective of improving calibration data quality by developing new data acquisition and data analysis techniques. The standard cylinders can be made available to any RCS facility at cost.
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NEW VIDEO ON CHARPY IMPACT TESTING

To help customers of the Charpy impact-testing program, NIST is now distributing a video, "How Tough is Steel." The 20 min video begins with a background of the Charpy test, then covers the details of the verification program run by NIST, and finally summarizes the procedures that will improve the performance of these machines. The video was designed to supplement the information included in NIST Special Publication 960-4, Standard Practice Guide on Installing, Maintaining, and Verifying Your Charpy Impact Machine. The video has been produced in VHS and CDROM (MPEG1) formats. It is available from the NIST Charpy program coordinator by sending an e-mail to vigliotti@boulder.nist.gov.
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ISOTOPE REFERENCE STANDARDS DEVELOPED

The dating of important minerals and geologic materials depends upon accurate determinations of potassium (K) and argon (Ar) isotopic ratios, but significant interlaboratory disagreements (1 % to 2 %) exceed intralaboratory uncertainties by an order of magnitude, hampering comparability of results. In response, and

under contract to the U.S. Geological Survey (USGS), NIST developed several all-metal argon isotope spike systems, each consisting of a reservoir and a Dorflinger pipette capable of delivering the required (2×10^{-10} to 4×10^{-10}) mol per aliquot. The ultra-low fill pressures (≈10 Pa) proved to be the major challenge in calibrating the spike systems with requisite uncertainty. Two spike systems deliver pure ^{38}Ar and three deliver artificial mixtures of ^{40}Ar / ^{36}Ar with uncertainties of approximately 0.1 % to 0.2 % for both amount of gas delivered and for isotopic ratios of the mixtures.

The Ar spike systems will be used by the USGS to calibrate their mass spectrometric techniques and ultimately measure the Ar concentration in a new preparation of their monitor mineral MMhb-2, which is a reference standard used for calibration and interlaboratory comparisons. The data, when combined with K concentration data from NIST, will enable the K/Ar age for MMhb–2 to be determined with a 10-fold improvement in uncertainty over existing methods, significantly surpassing USGS expectations. The MMhb–2 will also be certified by NIST for potassium and argon concentrations and distributed as an SRM that will be used by major argon dating laboratories along with the spike systems to resolve longstanding differences among laboratories, both in the United States and abroad.

As an ancillary benefit, the spike systems also will enable the USGS to re-measure the isotopic composition of atmospheric argon and calculate a new atomic weight for argon.

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NIST RESEARCHERS COMPLETE INTERNATIONAL INTERCOMPARISON OF OPTICAL FIBER POWER MEASUREMENTS

NIST researchers recently completed an international intercomparison of optical fiber power measurements with researchers from Physikalisch-Technische Bundesanstalt (PTB). This work, which has been submitted to *Metrologia*, is part of an ongoing effort to reduce the overall uncertainty of laser and optical fiber power meter (OFPM) calibrations.

This past summer, a novel NIST transfer standard based on germanium photodiodes was used in an intercomparison of OFPMs with PTB at nominal wavelengths of 1300 nm and 1550 nm (wavelengths at which most of the world's optical-fiber-based communication is transmitted). Measurement results showed differences of less than 1.5×10^{3}—well within the combined uncertainty for both laboratories—demonstrating that optical fiber power measurements from the laboratories are among the best in the world. The NIST transfer standard, developed as part of an ongoing effort to provide lower uncertainty for OFPM calibrations, has a coupling efficiency very near unity up to a numerical aperture (NA) of 0.26. This is very important for applications such as optical fiber where the light incident on the detector has a large angular divergence. The transfer standard can be calibrated directly against a primary standard with collimated radiation as well as being used to accurately measure optical power from a fiber, without intervening optics.

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USAXS IMAGING USED TO STUDY ARTIFICIAL TISSUE SCAFFOLDS

A team of NIST scientists previously developed a high-resolution (better than 1 μm) synchrotron x-ray imaging technique whereby three-dimensional microstructures can be obtained using ultra-small-angle x-ray scattering (USAXS). This method uses a radically different, high-contrast mechanism that provides information that is unobtainable using conventional x-ray imaging techniques. Using the NIST USAXS instrument at the UNICAT beamline at the Advanced Photon Source (Argonne National Laboratory), this new imaging technique has now been applied to the study of artificial biocompatible-polymer tissue scaffolds that hold great promise for growing artificial human tissues for implantation. Images were acquired while the samples were rotated in 0.5° increments, allowing detailed three-dimensional information to be obtained. The images clearly show the presence of both large connected cavities necessary for the transport of nutrients and wastes, and small crystallites on the surfaces of these cavities that can affect the growth of human cells. These same samples will also be imaged using complementary three-dimensional optical imaging techniques (optical coherence tomography) that were developed by NIST.

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X-RAY POROSIMETRY: A NEW METHOD FOR THE CHARACTERIZATION OF POROUS LOW-DIELECTRIC-CONSTANT THIN FILMS ADAPTABLE FOR THE SEMICONDUCTOR INDUSTRY

NIST scientists have developed a new measurement method—x-ray porosimetry (XRP)—for characterization of porous low-dielectric-constant (low-*k*) films. The method has application to the semiconductor industry in their pursuit of new interlayer materials with low dielectric constants to reduce cross-talk and to increase processor speed as device features reach nanometer sizes. While candidate materials differ in their base chemistries, a common theme emerges in the push to develop low-*k* dielectric materials—nano-scale porosity must be introduced in a controlled manner to further reduce the dielectric constant. Measurement techniques are needed to accurately and noninvasively characterize the porosity in these films while attached on a silicon substrate. Over the past several years, NIST scientists in the Polymers Division and at the Center for Neutron Research have successfully addressed these needs through the development of a methodology based upon x-ray reflectivity (XR), small angle neutron scattering, and ion scattering. However, these measurements require specialized facilities not readily accessible to industrial laboratories. In contrast, the new method requires x-ray equipment commercially available to industrial laboratories.

In the new method, a controlled solvent environment is created around the thin film so that an equilibrium amount of adsorption occurs. Under such conditions, XR instrumentation gives accurate values of the total density that is a combination of wall density and solvent-filled pores. The mass uptake as a function of partial pressure is calculated from these results.

An additional potential advantage of XRP is the ability to quantify not only the average film density, but also the density profile normal to the film surface. Ongoing work investigates the potential of XRP to extract pore size distributions as a function of depth into film. To prevent dielectric breakdown, the semiconductor industry prefers to have low porosity or very small pores near the surfaces with the majority of the porosity in the localized in the center of the thin film. XRP has the potential to become a useful method for characterizing these types of structures using commercially available XR within industrial laboratories.

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NIST RESEARCHER HIGHLIGHTS CHALLENGES OF "TALKING CERAMICS"

In the last three decades, communications technologies have been completely transformed by the “wireless revolution.” Devices such as cell phones are now so common that many consumers are forgoing the hard-wired versions altogether. This remarkable technological explosion could not have taken place without several key historical events, such as Marconi’s first wireless transmission across the Atlantic Ocean in 1901, and the discovery of the transistor almost 50 years later.

Critical to the proliferation of microwave communications was the discovery of a small number of ceramic materials with special properties permitting them to be used as dielectric resonators and filters, thereby enabling them to function as “talking ceramics.” Although the theoretical possibilities and potential applications of dielectric resonators were recognized in 1939, it was not until the 1970s that ceramics with the required dielectric properties were discovered by researchers at NIST and a private company. The construction of commercially viable cellular base stations resulted directly from that work. In the ensuing two decades, wireless applications proliferated while the size and weight of user devices plummeted.

Today, dielectric ceramics are critical ingredients of resonators, filters, and other key components supporting the $40 billion wireless communication industry. The success of this technology has created an unending demand for better materials, as described by NIST staff in “Talking Ceramics,” an invited article published in the Nov. 8, 2002, issue of *Science.* New microwave ceramics, the article explains, are needed to accommodate an increasingly crowded communications spectrum and improve device and base station capabilities, while limiting or reducing manufacturing costs. This situation presents a considerable challenge to materials scientists because designing materials with the desired properties requires an understanding that is not yet currently available.

NIST is responding to this challenge by its aggressive pursuit of research on the phase equilibria and dielectric properties of these important ceramics. The *Science* article describes several recent accomplishments by NIST materials scientists and others that are helping to place the search for new dielectric ceramics on a more solid theoretical foundation. In addition, promising, but still exploratory approaches to designing and fabricating new types of dielectric materials are noted.

The full text of the article can be found at www.ceramics.nist.gov. The article also was the focus

of a feature story that appeared in *The New York Times* on Nov. 28, 2002, and of a NIST news release that can be found at www.nist.gov/public_affairs/releases/n02-22.htm.
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NIST EXPERIMENT'S DATA ACQUIRED BEFORE SPACE SHUTTLE TRAGEDY

NIST scientists used an experiment aboard the STS-107 mission of the space shuttle Columbia to look for a particular type of flow behavior, never before seen in a pure liquid, that may have practical applications in products ranging from paints and plastics to foods and pharmaceuticals. Almost all of the data from the experiment—sent by telemetry to the ground during the mission—were acquired before the tragic loss of the shuttle orbiter and its seven-member crew on Feb. 1, 2003.

The "Critical Viscosity of Xenon-2" (CVX2) experiment measured the changes in viscosity (resistance to flow) of a xenon sample as it was stirred rapidly and approached the "critical point." Xenon, an inert gas, exhibits unusual behavior near its critical point, at which it turns into a milky fluid with properties between those of a liquid and a gas. The experiment was conducted in the microgravity of orbit because the changes in viscosity that take place in the critical state cannot be measured accurately in Earth's gravity.

The experimental data should reveal whether xenon exhibits "shear thinning," meaning its usual resistance to flow is weakened by a large shear rate. Although predicted for decades, shear thinning has never been observed near the critical point of any pure fluid. Xenon, a pure fluid with a very simple structure and a critical temperature just below room temperature, is convenient for such experiments. The data may help scientists better understand shear thinning in complex fluids such as paints and foods (e.g., whipped cream), which need to flow easily during application and stand firm afterwards.

The latest results will expand on those gathered during a 1997 NIST space shuttle experiment, which accurately measured the viscosity of xenon and revealed a viscosity increase of 37 %—double the best measurements on Earth. That experiment also showed that xenon, when close to the critical point, is partly elastic; that is, it can "stretch" as well as flow.
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NIST-DEVELOPED OOMMF SOFTWARE HELPS TO ENABLE ONE OF THE TOP 10 PHYSICS ADVANCES IN 2002

Object-Oriented MicroMagnetic Framework (OOMMF) software, developed by NIST mathematicians, helped to enable one of the top advances in physics last year. The Institute of Physics recently listed their top 10 stories in physics for 2002 on the Web at http://physicsweb.org/article/news/6/12/14. Number 7 on the list is the development of a nanoscale magnetic logic gate and shift register by a team at the University of Durham. As reported in their article in *Science* last June (www.sciencemag.org/cgi/content/full/296/5575/2003), the team used OOMMF to determine the appropriate device widths for containing and controlling the magnetic domain walls. The controlled motion of the walls between magnetic domains is what enables fully magnetic logic operations.
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NIST DEMONSTRATES HYBRID WAVELENGTH CALIBRATION REFERENCE

NIST scientists have have developed a multiple-wavelength calibration reference that incorporates the wavelength flexibility of fiber Bragg grating artifact references and the stability of fundamental molecular absorption references. A prototype wavelength calibration unit was demonstrated at the Navy Primary Standards Laboratory, San Diego, CA, in December 2002.

Wavelength calibration references are needed to calibrate wavelength-measuring instruments such as optical spectrum analyzers. Atomic and molecular absorption lines are very stable under changing environmental conditions and are excellent references for this purpose. Unfortunately, good atomic or molecular candidates are not available in all wavelength regions. Customized multiple wavelength reflectors can be generated by writing multiple superimposed fiber Bragg grating (FBG) reflectors into optical fiber using ultraviolet light. Each grating is a reflector for a specific wavelength of light; the wavelengths are selected during the grating fabrication process. Strain and temperature changes, however, can cause the center wavelength of these reflectors to change; the temperature sensitivity is about 0.01 nm/°C. If one of the FBG reflectors is located near an atomic or molecular absorption line, it can be actively stabilized to that line. This stability is then transferred to the other gratings, because they are

super-imposed at the same location in the fiber. Once the wavelength of each FBG reflection peak is measured at NIST, all of the peaks can be used as calibration references. The NIST prototype uses interleaved sampled FBGs to produce multiple peaks in the 1300 nm and 1550 nm regions. The unit provides eight calibration references between 1297 nm and 1306 nm and 12 references between 1531 nm and 1550 nm, each with a stability of a few picometers. NIST scientists are now investigating methods to incorporate calibration references in the 850 nm region.

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NIST DISCOVERS HOW TO LIMIT THE MAGNETIC SUBSTRATE EFFECT IN COATED SUPERCONDUCTORS

In 2001, NIST researchers showed that magnetic substrates reduced the current carrying capacity of Y-Ba-Cu-O coated superconductor tapes when arranged in stacks of two or more layers. They have now discovered that the degradation in critical current due to the magnetic substrate effect can be mitigated significantly if a spacing layer is inserted between the superconductor film and the magnetic cap layer.

High-temperature superconducting tapes based upon coatings of Y-Ba-Cu-O on biaxially textured, buffered, magnetic Ni-W-Fe substrates showed a degradation of 12 % in critical current when the superconductor layer was sandwiched between two Ni-W-Fe substrates. The NIST researchers found that this degradation of critical current could be reduced dramatically to less than 1 % if a 300 μm thick Kapton tape was placed between the superconductor film and the magnetic cap layer. Such a spacing layer could naturally be incorporated into the manufacture of Y-Ba-Cu-O coated conductors as an insulating coating. Even a separation of just 50 μm reduces the degradation to 3 %.

The magnetic substrate effect resulting from sandwiching Y-Ba-Cu-O between two magnetic layers occurs in applications where the coated conductor needs to be wound or cabled. The spacing tape, which limits the magnetic interaction of the top and bottom Ni-W-Fe layers, represents an engineering solution for limiting performance degradation in low magnetic field applications such as underground power-transmission cables. The separation layer could be an insulatory layer for electrical isolation, or a high conductivity material, such as Cu, to enhance the electrical and thermal stability of the cable.

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NIST ISSUES DIGITAL RIGHTS MANAGEMENT (DRM) REFERENCE

In March 2002, experts at a NIST cross-industry DRM workshop recommended that NIST take first steps toward a guide of standards organizations active in the field. Assisted by numerous industry participants, NIST is now distributing a 15-page guide, NIST Special Publication 500-241, *A Quick-Reference List of Organizations and Standards for Digital Rights Management,* (October 2002). The guide is available electronically at www.nist.gov/SP500-241.

Today, digital rights management, sometimes called intellectual property management and protection, is a chaotic, noisy mix of technology, policy, law, and business practice. Nonetheless, areas of real success are appearing. College e-text publishing now shows profits for several major New York publishers, with rates of growth approaching 60 % a year. Several electronic newspaper multimedia formats are in progress. The promise of the technology has attracted several government agencies that want to protect their sensitive documents. Similarly, the academic community is proposing a scholarly works system tied to the development of Internet II.

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NIST DEVELOPS METHODS FOR ELASTIC STRAIN FIELD MAPPING IN SEMICONDUCTOR HETEROSTRUCTURES

NIST researchers are developing methods for detecting and quantifying, with high spatial resolution (sub 100 nm diameter), the elastic strains associated with selective wet oxidation of AlGaAs confined between GaAs layers. The AlGaAs to aluminum oxide transition is accompanied by volumetric compressive strains in excess of 6 %, sometimes leading to detrimental stress relaxation in the form of delamination or dislocation formation. The industry need is to measure and control elastic strain development in such systems. Automated electron backscatter diffraction measurements have revealed both the extent of the elastic strain field in the neighborhood of an oxide growth front as well as the magnitude of elastic strain at any position in that field. The extent of the field is in the range of micrometers about the front, and becomes apparent through mappings of pattern sharpness. Researchers suggest that pattern sharpness, which is a measure of the distribution of lattice spacings, decreases as the magnitude of the localized elastic strain gradient increases within the sampling volume of the electron beam. The magnitude of elastic strain is measured by means of lattice

spacing determinations from Kikuchi bandwidths, with a resolution approaching 0.1 % strain.
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MAGNETIZATION DYNAMICS MODELED IN MAGNETIC THIN FILMS

One of the challenges facing designers of high data rate computer hard drives and magnetic memory chips is that for most magnetic metals, it typically takes a few nanoseconds for the magnetization to come to rest after it has been switched or "bumped" by a magnetic field pulse. In hard drives, for example, the damping process is important for the write head that generates field pulses, the media that switch to record the field pulses as a magnetization pattern, and for the read head sensors that detect the fields from the recorded pattern. A nanosecond scale damping time makes it inherently difficult to design devices that will operate at data rates greater than 1 GHz.

The most common technique to assess magnetization damping in magnetic films is to measure the ferromagnetic resonance line width of the material. However, films of interest are seldom perfectly uniform, and meas-ured line width reflects both the damping and the defects in the sample. NIST researchers have developed a line width model that takes the defects into account and predicts the changes in line width that would be observed based on the type and strength of inhomogeneity.

An earlier model of line width covers the limit of very small, weak defects where the magnetization is expected to behave mostly uniformly. In the opposite limit of strong, large defects, the magnetization was expected to behave differently in different parts of the film, but it has not been clear what size defect was necessary for this local behavior to take place. The new model bridges the theoretical gap between weak defect and strong defect limits and establishes the conditions needed for local behavior.

The new model allows line width data to yield separate information about damping and non-uniformity, and for some data sets, limits may be placed on the defect sizes, thus allowing much better characterization of magnetic recording media, heads, and other devices designed for GHz applications.
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SIMULTANEOUS BIAXIAL STRESS AND COMPOSITION MEASUREMENTS MADE ON $Al_x\ Ga_{1-x}\ As$ THIN FILMS

Raman and photoluminescence peak shift measurements have been made on $Al_xGa_{1-x}As$ thin films to determine simultaneously both biaxial stress and Al composition (x). $Al_xGa_{1-x}As$ forms a family of materials used in multilayer thin film structures for photodiode sources and detectors. Residual stresses in the devices affect operating wavelength, electron-hole recombination rate, and mechanical reliability. Although shifts in the Raman peak position previously have been used to determine stress in Si-based devices, that approach could not be used in $Al_xGa_{1-x}As$ because both stress and composition change shift the Raman peak position in this compound system. Until the Raman peak positions were calibrated for both x and stress, it was not clear whether contributions from the two effects could be separated.

NIST scientists used a set of films to demonstrate that combining Raman and photoluminescence measurements permits separation of composition-induced peak shifts from stress-induced peak shifts, allowing simultaneous evaluation of stress and composition. This approach is not expected to be limited to the $Al_xGa_{1-x}As$ family, but is thought to be applicable to a wide range of compound semiconductor materials.
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UPDATED DIRECTORY OF STATE AND LOCAL GOVERNMENT LABORATORY ACCREDITATION/DESIGNATION PROGRAMS ISSUED

A new edition of NIST Special Publication (SP) 815, *Directory of State and Local Government Laboratory Accreditation/Designation Programs*, has been issued. The updated SP 815 is a guide to state and local government laboratory accreditation and similar programs that accredit or designate laboratories or other entities to conduct testing that assists agencies in carrying out their responsibilities. Such accreditation or designation is based on assessment of a laboratory's capability to conduct specified testing, but the nature of the assessments differs considerably among agencies. Directory entries are based primarily on information

provided by state and local government agencies, reflecting the agency's view of its activities. SP 815 is part of ongoing NIST efforts to provide comprehensive information on standards, regulations, laboratory accreditation and certification programs, and related information. The directory is available on the Web at http://ts.nist.gov/ts/htdocs/210/gsig/pubs/sp815-02.pdf.
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NIST DEVELOPS DATABASE FOR GSA

NIST's Office of Applied Economics has partnered with the GSA Public Building Service's Environmental Strategies and Safety Division to promote construction waste recycling. The result is the Construction Waste Management Database Web site that contains a searchable database of almost 2000 construction waste recyclers nationwide.

The database contains the name, location, and other key information on companies that haul, collect, and process debris from construction projects. A user can search the database by company, city, state, and material(s) accepted. The database is the first to include an all-in-one list of construction waste recyclers.

The site has been accessed over 3300 times since its August 2002 launch. It is available at http://cwm.gsa.gov.
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SOLUTION KINETICS DATABASE ON THE WEB

A Solution Kinetics Database, jointly created by NIST and the Notre Dame Radiation Laboratory, has been made available on the Internet in a format similar to that utilized by the popular NIST Kinetics Database, which covers gas-phase reactions. The Solution Kinetics Database, which can be found at http://kinetics.nist.gov/solution, contains over 23 000 rate constants, primarily for free radical reactions. More than 11 000 unique species in more than 150 solvents or mixtures of solvents are included. The data have been abstracted from nearly 4000 literature sources. This database includes reactions of many compounds of industrial and biochemical interest, such as antioxidants, vitamins, dyes, photosensitizers, radiosensitizers, radioprotectors, amino acids, and enzymes; and provides kinetic information on many unstable species of physiological and atmospheric importance. The database is linked to the NIST Chemistry WebBook wherever possible, making additional chemical and physical property data on the chemical species available at the click of a mouse.
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NIST/INDUSTRY COLLABORATION YIELDS NEW INSTRUMENTATION FOR MONITORING NANOCOMPOSITES COMPOUNDING

In collaboration with an instrument company, NIST scientists have developed on-line, real-time instrumentation for monitoring extrusion compounding of polymer/clay nanocomposites. The new instrument is a multi-functional device that addresses the need for instant characterization of the compounding process and the compounded product. The sensor device is a dielectric slit die that attaches to the end of a twin screw compounding extruder and measures the electrical, optical, rheological, and ultrasonics properties of the compounded product. The objective is to acquire a package of data from dif-ferent sensors in order to deduce information about the microstructure of the clay filler particles, and to determine if aggregate clay has dispersed and exfoliated into small nanosize particles within the polymer matrix. This information is important because it has been established that a few percent of clay mixed into the polymer can greatly enhance the mechanical and fire retardant performance of the composite if dispersion and exfoliation of the clay occurs.

The instrument project is part of a larger program to fully characterize polymer/clay nanocomposites using both on-line and off-line measurements. Off-line measurements, such as x-ray diffraction, NMR spectroscopy, and neutron scattering, are correlated with on-line data to give a detailed picture of the micro- and nanoscale structure of the nanocomposite.
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SURF PROVIDES CRITICAL CALIBRATION FOR NASA

In September 2002, a group from the Laboratory for Atmospheric and Space Physics (LASP) at the University of Colorado performed the final pre-flight calibration of the EOS SORCE (SOLar Radiation and Climate Experiment) SOLSTICE (SOLar STellar Irradiance Comparison Experiment) A instrument. The calibration was carried out on the NASA-supported spectrometer calibration beam line at the NIST Synchrotron Ultraviolet Radiation Facility (SURF III).

This beam line provides a well-characterized source of structureless continuum radiation from 2 nm to 400 nm with a relative uncertainty of 1 % or better.

This version of SOLSTICE is a component of the SORCE satellite that was launched on a Pegasus XL launch vehicle on Jan. 25, 2003. SORCE is a key component of NASA's Earth Observing System (EOS) program and will carry four instruments to measure the solar radiation incident at the top of the Earth's atmosphere (640 km altitude). SOLSTICE consists of a pair of identical spectrometers that will measure spectral irradiance from 115 nm to 300 nm with a resolution of 0.2 nm, and with an absolute uncertainty of better than 5 % and a relative uncertainty of better than 1 %.

Solar ultraviolet radiation at wavelengths below 300 nm is totally absorbed by the Earth's atmosphere. It is the major energy source in the stratosphere and thermosphere and thus determines the upper atmosphere's temperature, structure, composition, and dynamics. Even small variations in the sun's radiation at these short wavelengths lead to significant changes in atmospheric chemistry. SORCE will accurately monitor both the total solar irradiance and its spectral dependence over a period of at least 5 years.

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