NISTIR 4423

Center for Electronics and Electrical Engineering

Technical Publication Announcements

Covering Center Programs,
January to March 1990,
with 1990 CEEE Events Calendar

U.S. DEPARTMENT OF COMMERCE
National Institute of Standards and Technology
Center for Electronics and Electrical Engineering
Semiconductor Electronics Division
Gaithersburg, MD 20899

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Robert A. Mosbacher, Secretary
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INTRODUCTION TO THE CEEE TECHNICAL PUBLICATION ANNOUNCEMENTS

This is the twenty-fourth issue of a quarterly publication providing information on the technical work of the National Institute of Standards and Technology (formerly the National Bureau of Standards) Center for Electronics and Electrical Engineering. This issue of the CEEE Technical Publication Announcements covers the first quarter of calendar year 1990.

Organization of Bulletin: This issue contains citations and abstracts for Center publications published in the quarter. Entries are arranged by technical topic as identified in the table of contents and alphabetically by first author within each topic. Following each abstract is the name and telephone number of the individual to contact for more information on the topic (usually the first author). This issue also includes a calendar of Center conferences and workshops planned for calendar year 1990 and a list of sponsors of the work.

Center for Electronics and Electrical Engineering: Center programs provide national reference standards, measurement methods, supporting theory and data, and traceability to national standards.

The metrological products of these programs aid economic growth by promoting equity and efficiency in the marketplace, by removing metrological barriers to improved productivity and innovation, by increasing U.S. competitiveness in international markets through facilitation of compliance with international agreements, and by providing technical bases for the development of voluntary standards for domestic and international trade. These metrological products also aid in the development of rational regulatory policy and promote efficient functioning of technical programs of the Government.

The work of the Center is divided into two major programs: the Semiconductor Technology Program, carried out by the Semiconductor Electronics Division in Gaithersburg, MD, and the Signals and Systems Metrology Program carried out by the Electricity Division in Gaithersburg and the Electromagnetic Fields and Electromagnetic Technology Divisions in Boulder, CO. Key contacts in the Center are given on the back cover; readers are encouraged to contact any of these individuals for further information.

Center sponsors: The Center Programs are sponsored by the National Institute of Standards and Technology and a number of other organizations, in both the Federal and private sectors; these are identified on page 18.

Note on Publication Lists: Guides to earlier as well as recent work are the publication lists covering the work of each division. These lists are revised and reissued on an approximately annual basis and are available from the originating division. The current set is identified in the Additional Information section, page 12.

TABLE OF CONTENTS

SEMICONDUCTOR TECHNOLOGY PROGRAM

Silicon Materials

Mayo, S., Fassett, J.D., Kingston, H.M., and Walker, R.J., **Measurement of Vanadium Impurity in SIMOX Material by Isotope Dilution and Resonance Ionization Mass Spectrometry**, Analytical Chemistry, Vol. 62, No. 3, pp. 240-244 (February 1, 1990).

The combined analytical capabilities of isotope dilution, laser-induced resonance ionization spectroscopy, and mass spectrometry, integrated in the resonance ionization mass spectrometry technique (RIMS), have been evaluated as a tool for quantitative elemental impurity analysis of SIMOX, a new silicon-based material prepared by oxygen implants. The vanadium impurity content was measured in the top crystalline SIMOX film and the oxygen-synthesized buried oxide layer in commercial wafers, resulting in a 0.1 μg/g ± 20 percent, or 1.7 x 10^{15} atoms/cm^3. A similar analysis on the substrate bulk shows about thirty times lower vanadium impurity levels. The origin of this contamination is linked to the oxygen implant although no modeling for it is offered here. The sensitivity of RIMS to vanadium is in the pg/g range. The accuracy of results is determined by the blank, in view of the low total vanadium in the specimen.
[Contact: Santos Mayo, (301) 975-2045]

Integrated Circuit Test Structures

Cresswell, M.W., Khera, D., Linholm, L.W., and Schuster, C.E., **Test Structure Data Classification Using a Directed Graph Approach**, Proceedings of the IEEE 1990 International Conference on Microelectronic Test Structure, San Diego, California, March 5-7, 1990, Vol. 3, pp. 193-198 (March 1990).

This paper introduces directed graph techniques to serve as an expert system rule generator by classifying selections of tested wafers into groups based on similarities of the spatial distributions of their parametric test structure measurements. The rules can be used to supplement rules derived by other means for diagnostic process analysis, work-in-process wafer screening, and yield and reliability management.
[Contact: Michael W. Cresswell, (301) 975-2072]

Other Semiconductor Metrology Topics

Suehle, J.S., and Schafft, H.A., **Current Density Dependence of Electromigration t_{50} Enhancement Due to Pulsed Operation**, Proceedings of the 1990 International Reliability Physics Symposium, New Orleans, Louisiana, March 27-29, 1990, pp. 106-110 (March 1990).

Two effects that complicate the electromigration characterization of metallization for pulsed stress have been observed. One is the dependence of the t_{50} enhancement (due to pulsed operation) on current density, and the other is a decrease of this enhancement over a range of frequencies (0.2 to 2 MHz) that is connected with the joule heating. These effects are discussed in terms of changes in the buildup and relaxation response times of the excess vacancy concentration.
[Contact: John S. Suehle, (301) 975-2247]

SIGNALS & SYSTEMS METROLOGY PROGRAM

FAST SIGNAL ACQUISITION, PROCESSING, AND TRANSMISSION

Waveform Metrology

Gans, W.L., **Dynamic Calibration of Oscilloscopes and Waveform Recorders Using Pulse Standards**, Conference Record of the IEEE Instrumentation and Measurement Technology Conference, San Jose, California, February 13-15, 1990, pp. 246-250 (1990).

The purpose of this presentation is to convince the reader/listener of two key

Waveform Metrology (cont'd.)

points. The first is that virtually no one calibrates oscilloscopes/waveform recorders properly and completely at present. The second is that, in most cases, the tools are now available to perform these complete and proper calibrations when the application requires it. After a brief introduction describing the current methods used to calibrate oscilloscopes, the problems associated with these methods are discussed and illustrated. The solutions to these problems are then described.
[Contact: William L. Gans, (303) 497-3538]

Laug, O.B., **A High-Current, Very-Wide-Band Transconductance Amplifier**, IEEE Transactions on Instrumentation and Measurement, Vol. 39, No. 1, pp. 42-47 (February 1990).

A new design approach for a high-current, very-wide-band transconductance amplifier is described. The approach is based on paralleling the input and output of complementary unipolar current-mirror cells. Each cell has a fixed current gain determined by the ratio of two resistors. A differential input voltage-to-current circuit drives the cell array. The design has the advantage of avoiding the need for a single low-resistance current-sensing resistor and the attendant problems inherent in such resistors. Although the concept is still under development, a prototype of the cell-based transconductance amplifier was implemented with ten positive and ten negative current cells to gain some experimental familiarity with the approach, in addition to providing verification of computer simulation results. The prototype transconductance amplifier is dc coupled, has a 3-dB bandwidth of about 750 kHz, and can deliver up to 35 A rms at 100 kHz with an output compliance voltage of 5 V rms. Other important characteristics, such as output load regulation and dc offsets, are discussed.
[Contact: Owen B. Laug, (301) 975-2412]

Oldham, N.M., Bruce, W.F., Fu, C.M., and Smith, A.G., **An Intercomparison of AC Voltage Using a Digitally Synthesized Source**, IEEE Transactions on Instrumentation and Measurement, Vol. 39, No. 1, pp. 6-9 (February 1990).

An ac voltage intercomparison was conducted by the National Institute of Standards and Technology (NIST) to determine the consistency of ac voltage measurements made at various standards laboratories. The transport standard used for this purpose was an NIST-developed digitally synthesized sinusoidal voltage source whose rms value is calculated by measuring the dc level of each of the steps used to synthesize the sine wave. The uncertainty of the calculated voltage at the 7-V level is typically within ±10 parts per million (ppm) from 15 Hz to 7.8 kHz. This approach represents a technique of referring ac voltage to a standard dc voltage, which is independent of the traditional thermal-voltage-converter approach. Preliminary measurements made at each of the participating laboratories agree with the calculated value to within ±20 ppm. This would indicate that, at the 7-V level in the low audio-frequency range, the ac voltage measurement techniques implemented at these laboratories are near the state of the art.
[Contact: Nile M. Oldham, (301) 975-2408]

Souders, T.M., Flach, D.R., and Blair, J.J., **Step and Frequency Response Testing of Waveform Recorders**, Proceedings of the IEEE Instrumentation and Measurement Technology Conference, San Jose, California, pp. 214-220, February 13-15, 1990.

Tutorial material is presented to aid in measuring the step response of waveform recorders, and to compute other parameters which may be derived from it.

Waveform Metrology (cont'd.)

Parameters considered include impulse response, transition duration, settling time, and complex frequency response. The measurement approaches follow those recommended in the IEEE "Trial Use Standard for Digitizing Waveform Recorders." Illustrated examples are given, and guidelines on the choice of step generators are also included.
[Contact: T. Michael Souders, (301) 975-2406]

Souders, T.M., Flach, D.R., Hagwood, C., and Yang, G., **The Effects of Timing Jitter in Sampling Systems**, IEEE Transactions on Instrumentation and Measurement, Vol. 39, No. 1, pp. 80-85 (February 1990).

Timing jitter generally causes a bias in the amplitude estimates of sampled waveforms. Equations are developed for computing the bias in both the time and frequency domains. Two principal estimators are considered: the sample mean and the so-called Markov estimator used in some equivalent-time sampling systems. Examples are given using both real and simulated data.
[Contact: T. Michael Souders, (301) 975-2406]

Fundamental Electrical Measurements

Cage, M.E., Yu, D.Y., and Reedtz, G.M., **Observation and an Explanation of Breakdown of the Quantum Hall Effect**, Journal of Research of the National Institute of Standards and Technology, Vol. 95, No. 1, pp. 93-99 (January-February 1990).

We observe spatially localized breakdown of the nearly dissipationless quantum Hall effect regime into a set of discrete dissipative states in wide, high-quality GaAs/AlGaAs samples. The phenomenon can be explained by quasi-elastic inter-Landau level scattering. We propose the existence of a new, highly efficient population inversion mechanism and the possible existence of an acoustic phonon laser.
[Contact: Marvin E. Cage, (301) 975-4248]

Coogan, P.C., Ricketts, B.W., Small, G.W., Cage, M.E., Dziuba, R.F., and Shields, J.Q., **Comparisons of the NML and NIST Representations of the Ohm Using Transportable 1 Ω, 10 kΩ, 10 pF, and Quantized-Hall-Resistance Standards**, Metrologia, Vol. 26, pp. 229-234 (Springer-Verlag, 1989).

The laboratory or as-maintained ohm representations of the National Measurement Laboratory (NML) in Australia and the National Institute of Standards and Technology (NIST) in the United States have been compared by four different methods. These methods involved the transport and intercomparison, over a 15-month time period, of three 1-Ω resistors on two occasions, one 10-kΩ resistor, three 10-pF capacitors on two occasions, and one quantized Hall device. The excellent agreement of the comparisons of the ohm representations Ω_{NML} and Ω_{NIST} obtained by the four methods provides rigorous tests of the accuracies of 15 different measurement systems used at the two laboratories. The weighted mean of the difference between Ω_{NML} and Ω_{NIST} was found to be (1.3664 ± 0.0081) ppm for 1 January 1986.
[Contact: Marvin E. Cage, (301) 975-4248]

Van Degrift, C.T., Cage, M.E., and Girvin, S.M., **Resource Letter QHE-1: The Integral and Fractional Quantum Hall Effects**, Am. J. Phys., Vol. 58, No. 2, pp. 109-123 (February 1990).

This Resource Letter provides a guide to the literature on the integral and fractional quantum Hall effects. The letter E after an item indicates elementary level or material of general interest to persons becoming informed in the field. The letter I, for intermediate level, indicates material of somewhat more specialized nature; and the letter A indicates rather

Fundamental Electrical Meas. (cont'd.)

specialized or advanced material. An asterisk (*) indicates articles that we feel are especially useful or interesting; a double asterisk (**) indicates those articles to be included in an accompanying reprint book.
[Contact: Craig T. Van Degrift, (301) 975-4248]

Cryoelectronic Metrology

Martinis, J.M., and Kautz, R.L., **Classical Phase Diffusion in Small Hysteretic Josephson Junctions**, Physical Review Letters, Vol. 63, No. 14, pp. 1507-1510 (2 October 1989).

The existence of classical phase diffusion in hysteretic junctions is demonstrated by quantitative agreement between experimental and simulated I-V curves. The simulations are based on a circuit that accurately models both the junction and its external shunting impedance at microwave frequencies. We show that the bias current at which the junction switches from the phase-diffusion state to the voltage state is sensitive to dissipation at microwave frequencies.
[Contact: John M. Martinis, (303) 497-3597]

McDonald, D.G., **Superconductivity and the Quantization of Energy**, Science, Vol. 247, pp. 177-182 (12 January 1990).

Ideas about quantized energy levels originated in atomic physics, but superconductivity provides energy levels with unparalleled precision: 3 parts in 10^{18} at an energy of 0.0003 eV, in recent work by Jain, Lukens, and Tsai. The fact that the myriad of interactions of 10^{12} particles in a macroscopic body, a Josephson junction, can produce sharply defined energy levels suggests a dynamical state effectively divorced from the complexities of its environment. The existence of this state, the macroscopic quantum state of superconductors, is well established, but its isolation from intrinsic perturbations has recently been shown to be extraordinary. These new results, with an improved accuracy of about 10 orders of magnitude, are discussed in the context of highly accurate results from quantum electrodynamics, atomic spectroscopy, and the standards of metrology. Further refinements in accuracy may be achievable at higher energy levels, about 12 eV, as they become available from a new series array of 18992 Josephson junctions.
[Contact: Donald G. McDonald, (303) 497-5113]

Savageau, J.E., and McDonald, D.G., **Superconducting Inductance Bolometer with Potential Photon-Counting Sensitivity**: A Progress Report, Inst. Phys. Conf. Ser. No. 92 (paper presented at the International Conference Optical Radiometry, NPL, London, England, April 12-13, 1988), pp. 39-46 (1989).

This bolometer is based on the temperature dependence of the inductance of a superconducting microstrip line. Since the device is superconducting, it has no Johnson noise. It can be impedance matched to an optimized SQUID preamplifier, the quietest of all amplifiers, and its bias current is relatively unrestricted by self-heating. We show theoretically that this device can have a sensitivity comparable to that of an optical photon counting detector, or an NEP_e of 5.4×10^{-18} W/√Hz. Our experimental prototype device is designed to test the theory of operation, but not at the highest levels of sensitivity.
[Contact: Joseph E. Savageau, (303) 497-3770]

Antenna Metrology

Francis, M.H., Kremer, D.P., and Repjar, A.G., **Advanced System Characterizes Antennas to 65 GHz** [original title: Antenna Measurements at Millimeter Frequencies], Microwaves & RF, pp. 77

Antenna Metrology (cont'd.)

ff. (March 1990).

In the past, few antenna measurements above 30 GHz have been done by the National Institute of Standards and Technology (NIST). Recently, NIST has developed the capability to do antenna measurements at frequencies from 30 to 65 GHz. The extrapolation technique is used to determine the gain and polarization properties of antennas and probes with gains up to about 30 dB. The planar near-field technique is used for antennas with higher gains as well as for determining far-field antenna patterns for frequencies up to 50 GHz. This report describes the problems and the solutions for providing measurement capability at these frequencies. The problems that arise are primarily due to the small wavelengths at these frequencies requiring: (1) much better accuracies in the manufacture of flanges, (2) an improved technique for making insertion loss measurements, and (3) improved probe-positioning accuracy.
[Contact: Michael H. Francis, (303) 497-5873]

Microwave & Millimeter-Wave Metrology

Daywitt, W.C., and Counas, G.J., **Measuring Adapter Efficiency Using a Sliding Short Circuit**, IEEE Transactions on Microwave Theory and Techniques, Vol. 38, No. 3, pp. 231-237 (March 1990).

This paper describes a simple technique for measuring the efficiency of low-loss adapters that is useful in microwave applications where a few hundredths of a decibel error is acceptable. An expression for the efficiency error is given.
[Contact: William C. Daywitt, (303) 497-3720]

Electro-Optic Metrology

Hickernell, R.K., Aust, J.A., and Larson, D.R., **Optical Waveguide Attenuation Measured by Photothermal Displacement**, Conference Digest of the Sixth International Topical Meeting on Photoacoustic and Photothermal Phenomena, Baltimore, Maryland, July 31-August 3, 1989, pp. 310-311 (1990).

We apply the photothermal displacement technique to the study of propagation loss in optical channel waveguides. Thermal expansion of the substrate surface due to the absorption of guided light is probed with a laser beam reflected from the surface. The technique is noncontact, has a high spatial resolution, and is applicable to a wide variety of waveguides, including packaged devices. We measure attenuation in ion-exchanged glass waveguides at a wavelength of 1.3 μm.
[Contact: Robert K. Hickernell, (303) 497-3455]

Schlager, J.B., Yamabayashi, Y., and Franzen, D.L., **Recirculating Pulse Erbium-Fiber Ring Amplifier**, Optical Fiber Communication Conference Technical Digest, San Francisco, California, January 22-26, 1990, pp. 198 (1990).

Erbium-doped fiber amplifiers have produced up to a 34-dB optical gain at 1536 nm. Further increases in gain are accompanied by an increase in amplified spontaneous emission (ASE), which saturates the amplifier. This paper describes a gated erbium-fiber ring amplifier which avoids the problem of ASE buildup and unwanted feedback. Moreover, a large effective gain can be realized from a small single-pass gain by recirculating the pulse through the amplifier.
[Contact: John B. Schlager, (303) 497-3542]

Electromagnetic Properties

Geyer, R.G., **Electrodynamics of Materials for Dielectric Measurement Standardization**, Conference Record of the IEEE Instrumentation and Measurement Technology Conference, San Jose, Electromagnetic Properties (cont'd.)

California, February 13-15, 1990, pp. 2-7 (1990).

Dielectric reference materials are analyzed in light of the fundamental requirements of linearity, homogeneity, and isotropy. Generalized frequency- and temperature-dependent dispersion relations are reviewed which allow the prediction of broadband dielectric behavior from limited measurement data, determination of valid modal field structure in cavity or waveguide fixtures, and identification of discrepancies and errors in measurement data. An approach for examining the influence of deviations of sample homogeneity on a precisely specified electromagnetic field structure is outlined, and sufficient conditions for isotropic or uniaxial or biaxial anisotropic dielectric behavior are examined in terms of a material's chemical lattice physics. These characteristics direct the choices of suitable reference materials useful in dielectric metrology. Lastly, advances at the National Institute of Standards and Technology in both transmission/reflection and cavity resonator measurement techniques incorporating dielectric reference materials are noted.
[Contact: Richard G. Geyer, (303) 497-5852]

Complex Testing

Dai, H., and Souders, T.M., **Time Domain Testing Strategies and Fault Diagnosis for Analog Systems**, IEEE Transactions on Instrumentation and Measurement, Vol. 39, No. 1, pp. 157-162 (February 1990).

An efficient approach is presented for functional testing and parameter estimation of analog circuits in the time domain. The test equations are based on the sensitivity matrix, which can be obtained simultaneously with the nominal solution vector. Two examples are given, with results based on actual measurement data. Practical considerations, including the effects of ambiguity groups, measurement errors, and time skew are covered. The approach can be directly extended to nonlinear circuits.
[Contact: T. Michael Souders, (301) 975-2406]

Other Fast Signal Topics

Fickett, F.R., and Capobianco, T.E., **Standard Reference Materials for** Eddy **Current Nondestructive** Evaluation: **Research Material** 8458, Proceedings of the Measurement Science Conference, Anaheim, California, February 8-9, 1990, unpaged.

Eddy current nondestructive evaluation is widely used in the world of transportation, and especially in evaluation of the structural integrity of aircraft. Small cracks, subsurface cracks, and cracks forming in places where access is difficult, such as bolt holes, can only be detected in the field by the use of electromagnetic methods. A large number of commercial instruments and their associated probes are available for this purpose. For optimum performance, these instruments must be calibrated. This is usually accomplished by measuring artificial flaws in the form of drill holes, spark-cut notches, or saw slots of varying dimensions in aluminum alloy plates. The problem with such calibrations is that these "standard" flaws bear little resemblance to an actual fatigue crack. Here we discuss the present situation in this field and describe research now underway at NIST to develop flaw Standard Reference Materials and Research Materials (RM) that more closely approximate the behavior of actual fatigue cracks. In particular, we will concentrate on a recently-issued RM (#8458) which is a prototype of such a crack standard.
[Contact: Fred R. Fickett, (303) 497-3785]

Kahaner, D.K., and Anderson, W.E., **VolksGrapher: A Fortran Plotting**

Other Fast Signal Topics (cont'd.)

Package User's Guide, Version 3.0, NISTIR 90-4238 (February 1990).

VolksGrapher is a FORTRAN callable library which permits users to create plots with minimum overhead. VolksGrapher originally written for PCs has also been ported to the Sun, VAX, and Convex. The plots can be viewed on the PC screen, on a SunView graphics window, or with Tektronix 4014 emulation software. Plots may be changed interactively. Modifications permitted include zooming, adding or changing text, translating and rotating text, changing page layout, axis scaling (e.g., linear to logarithmic), and axis limits. Hard copy of the plots can be in either PostScript, Tektronix, HPGL, or QMS format.
[Contact: William E. Anderson, (301) 975-2423]

Treado, M.J., Eliason, L.K., and Fulcomer, P.M., **Miniature Surveillance Recorders**, U.S. Department of Justice, National Institute of Justice, Technology Assessment, NIJ Standard-0226.00 (January 1990).

This standard is a technical document that specifies performance and other requirements equipment should meet to satisfy the needs of criminal justice agencies for high-quality service. Purchasers can use the test methods described in this standard to determine whether a particular piece of equipment meets the essential requirements, or they may have the tests conducted on their behalf by a qualified testing laboratory. Procurement officials may also refer to this standard in their purchasing documents and require that equipment offered for purchase meet the requirements. Compliance with the requirements of the standard may be attested to by an independent laboratory or guaranteed by the vendor.

Because this NIJ standard is designed as a procurement aid, it is necessarily highly technical. For those who seek general guidance concerning the selection and application of law enforcement equipment, user guides have also been published. The guides explain in nontechnical language how to select equipment capable of the performance required by an agency.
[Contact: P. Michael Fulcomer, (301) 975-2407]

ELECTRICAL SYSTEMS

Power Systems Metrology

Martzloff, F.D., and Gruzs, T.M., **Monitoring Power Quality**, Powertechnics Magazine, Vol. 6, No. 2, pp. 22-26 (February 1990).

The quality of the power supplied to sensitive electronic equipment is an important issue. Monitoring disturbances of the power supply has been the objective of various site surveys, but results often appear to be instrument-dependent or site-dependent, making comparisons difficult.
[Contact: Francois D. Martzloff, (301) 975-2409]

Martzloff, F.D., and Gruzs, T.M., **Systems and Instruments in Site Surveys**, Powertechnics Magazine, Vol. 6, No. 3, pp. 34-39 (March 1990).

Every on-site survey of power quality utilizes a variety of methods and instruments, requiring careful interpretation of survey results. A close examination of underlying assumptions in nine published surveys shows that some differences can be reconciled, but indicates the need for standards.
[Contact: Francois D. Martzloff, (301) 975-2409]

Van Brunt, R.J., **Processes Leading to SF_6 Decomposition in Glow-Type Corona Discharges**, The Physics of Ionized Gases (SPIG '88), pp. 161-172, (Nova Science Publishers, Inc., Commack, New York, 1989) [Proceedings of the 14th Summer School and International

Power Systems Metrology (cont'd.)

Symposium on the Physics of Ionized Gases, Sarajevo, Yugoslavia, August 15-19, 1988.]

Recent progress which has been made in understanding the fundamental gas-phase oxidation processes involving SF_6 in corona discharges is discussed here within the framework of a three-zone chemical kinetics model. Gaps in our knowledge about fundamental molecular interactions that are keys to a better understanding of SF_6 oxidation are discussed.
[Contact: Richard J. Van Brunt, (301) 975-2425]

Van Brunt, R.J., and Herron, J.T., **Fundamental Processes of SF_6 Decomposition and Oxidation in Glow and Corona Discharges**, IEEE Transactions on Electrical Insulation, Vol. 25, No. 1, pp. 75-94 (February 1990).

The current state of our knowledge about the fundamental collision processes involving electrons, ions, free radicals, and molecules needed to understand the gas-phase discharge chemistry in SF_6 is reviewed. It is shown that the electron-impact dissociation of SF_6 leading to reactive neutral fragments is the decomposition rate controlling factor in corona and glow discharges. Data on electron-impact cross sections for SF_6 are reviewed and used to compute SF_6 dissociation rates as functions of E/N for mixtures of SF_6 with O_2 and H_2O. The calculated and measured rates for subsequent gas-phase reactions involving the lower valence sulfur fluorides (SF_x, $x < 6$) and other reactive species like OH and O are also reviewed. The temperature and E/N dependencies of rates for F^- transfer reactions of SF_6^- with SOF_4, SO_2, SiF_4, and other species generated by discharge-induced oxidation of SF_6 are reviewed together with data on collisional electron detachment and ion conversion processes involving interactions of F^-, SF_5^-, and SF_6^- with SF_6. The relevance of these negative-ion molecule interactions to ion transport and oxidation rates in SF_6 is discussed. Rates for various slow gas-phase hydrolysis processes that can affect observed relative yields of oxidation by-products are also considered. Implications of the fundamental rate data reviewed here to recently proposed chemical kinetics models of corona and glow-type discharges in SF_6 are discussed.
[Contact: Richard J. Van Brunt, (301) 975-2425]

Superconductors

Ekin, J.W., **Ohmic Contacts to High-T_c Superconductors**, Proceedings of SPIE (The International Society for Optical Engineering, P.O. Box 10, Bellingham, Washington 98227), Vol. 1187, Processing of Films for High T_c Superconducting Electronics, pp. 359-364 (1989).

This note summarizes and gives references describing the details of a method for reducing high T_c contact surface resistivities, ρ_c, to the 10^{-10} Ω cm^2 range ($\rho_c \equiv RA$, where R is the contact resistance and A is the contact area). The reduction was obtained using both gold and silver contacts, and represents a decrease in contact resistivity by over eight orders of magnitude from that obtained using indium solder connections. We have obtained most of the results so far for $YBa_2Cu_3O_{7-\delta}$ (YBCO) but preliminary data for the Bi and Tl based compounds are also summarized.
[Contact: Jack W. Ekin, (303) 497-5448]

Ekin, J.W., Peterson, R.L., and Bray, S.L., **Critical Currents of High-T_c Superconductors: Pinning, Weak Links, Conduction Anisotropy, and Contact Resistivities** [original title: Effect of Small Coherence Length on the Critical Current of High-T_c Superconductors: Pinning, Weak Links, Conduction Anisotropy, and Contact Resis-

Superconductors (cont'd.)

tivities], Proceedings of the Materials Research Society International Meeting on Advanced Materials, Tokyo, Japan, 1988, Vol. 6, pp. 135-144 (1989).

The coherence length ξ of high-T_c superconductors is about an order of magnitude smaller than for conventional superconductors. This intrinsic difference has profound consequences for the transport properties of high-T_c superconductors. Because the pinning effectiveness of defects of average size $\langle D \rangle$ is greatest for $\langle D \rangle/\xi = 1$ and decreases rapidly for $\langle D \rangle/\xi < 1$, atomic scale defects are ineffective as pinning sites in conventional superconductors, but play an important role in high-T_c superconductors. Unfortunately, the small coherence length also makes atomic scale defects effective tunneling barriers in high-T_c superconductors. Thus, from the practical standpoint of producing high transport critical current J_c in high-T_c superconductors, the conventional problem of pinning force enhancement is replaced by weak-link minimization. The transport J_c is nearly independent of the angle between the applied magnetic field and the average transport current direction, indicating highly convoluted percolation paths in these materials. Conduction anisotropy is a secondary factor, but emerges as a prime determinant of transport J_c in the absence of weak link effects. The effect of conduction anisotropy on transport J_c is described in terms of a current-transfer model. A method used to achieve contact resistivities in the 10^{-10} Ω-cm^2 range is summarized.
[Contact: John W. Ekin, (303) 497-5448]

Goodrich, L.F., Goldfarb, R.B., and Bray, S.L., **Development of Standards for Superconductors Final Report, January 1988 - December 1989**, NISTIR 90-3935 (January 1990).

A cooperative program with the Department of Energy, the National Institute of Standards and Technology, other national laboratories, and private industry is in progress to develop standard measurement practices for use in large-scale applications of superconductivity. This report describes research for the period January 1988 through December 1989. It contains the results of critical current studies on a large conductor Reference Material, the effect of power-supply current ripple, the measurements of large conductors, and an interlaboratory comparison (round robin) of Nb_3Sn wires. Short-range variations in magnetic hysteresis loss in multifilamentary Nb_3Sn were studied. The results of participation in several interlaboratory comparisons are described.
[Contact: Loren F. Goodrich, (303) 497-3143]

Other Electrical Systems Topics

Martzloff, F.D., **A Review of Candidate Methods for Detecting Incipient Defects Due to Aging of Installed Cables in Nuclear Power Plants**, Proceedings of the Workshop on Power Plant Cable Condition Monitoring, San Francisco, California, February 16-18, 1988, pp. 25-1 to 25-11 (July 1988). [Also published as NBSIR 88-3774 (May 1988).]

Several types of test methods have been proposed for detecting incipient defects due to aging in cable insulation systems, none offering certainty of detecting all possible types of defects. Some methods constitute direct detection of a defect in the cable; other methods detect changes in electrical or non-electrical parameters from which inferences can be drawn on the integrity of the cable. The paper summarizes the first year of a program conducted at the National Bureau of Standards to assess the potential of success for in-situ detection of incipient defects by the most promising of these methods.
[Contact: Francois D. Martzloff, (301) 975-2409]

ELECTROMAGNETIC INTERFERENCE

Radiated Electromagnetic Interference

Kanda, M., **A Microstrip Patch Antenna as a Standard Transmitting and Receiving Antenna**, IEEE Transactions on Electromagnetic Compatibility, Vol. 32, No. 1, pp. 5-8 (February 1990). [Also published in the Digest of the International Symposium on Electromagnetic Metrology (ISEM '89), Beijing, China, August 16-19, 1989.]

This paper discusses the possibility of employing a microstrip patch antenna as a standard transmitting antenna. The intrinsic properties of the substrate used for the antenna are determined by careful impedance measurements. The experimental results indicate that the transmitting characteristics of a microstrip antenna can be theoretically determined from its geometry. The microstrip patch antenna discussed here is physically small (20-cm square for 450 MHz) and can be well matched to a power delivery system (standing-wave ratio = 1.17).
[Contact: Motohisa Kanda, (303) 497-5320]

Wu, D.I., and Kanda, M., **Comparison of Theoretical and Experimental Data for the Near Field of an Open-Ended Rectangular Waveguide**, IEEE Transactions on Electromagnetic Compatibility, Vol. 31, No. 4, pp. 353-358 (November 1989).

A comparison between theoretical and experimental data on the radiating near field of an open-ended waveguide (OEG) is presented. Two theoretical methods are examined. The first one is an approximation based on simple plane wave equations with the electric field expressed in terms of the gain of the OEG. The gain equation is an empirical equation obtained from scaled measured data. The second approach is based on far-field-to-near-field transformations. Its purpose is to provide an alternate method for computing the fields as well as to provide a means of assessing the accuracy of the first approach. Theoretical data computed using both methods are presented along with measured data obtained in the anechoic chamber. The discrepancy between the two theoretical approaches is typically less than 0.5 dB (while the discrepancy between the theoretical and experimental results is small) and increases with the distance between the OEG and the field point.
[Contact: Motohisa Kanda, (303) 497-5320]

Conducted Electromagnetic Interference

Martzloff, F.D., and Leedy, T.F., **Electrical Fast Transient Tests: Applications and Limitations**, Conference Record of the IEEE Industry Applications Society Annual Meeting, Part II, San Diego, California, October 1-5, 1989, pp. 1625-1632 (October 1989). [Also published in the Proceedings of the IEEE Industrial Applications Society 35th Annual Petroleum & Chemical Industry Conference, Dallas, Texas, September 12, 1988, pp. 1-8 (1988)].

The Technical Committee TC 65 of the International Electrotechnical Commission (IEC) has promulgated a new document (IEC 801-4) requiring demonstration of the immunity of industrial process control equipment to fast transients occurring in power and data lines. These fast transients contain high-frequency components, intuitively expected to suffer greater attenuation than the lower-frequency components as they propagate along the lines. Quantifying this intuitive expectation provides a perspective on the severity of the situation and helps in defining realistic test requirements. To that end, this paper describes specific measurements conducted for typical low-voltage power line configurations; modeling of the attenuation provides a tool for understanding the significance of the line parameters and extends the

Conducted EMI (cont'd.)

usefulness of results to general cases.
[Contact: Francois D. Martzloff, (301) 975-2409]

ADDITIONAL INFORMATION

Lists of Publications

Lyons, R.M., and Gibson, K.A., **A Bibliography of the NIST Electromagnetic Fields Division Publications**, NISTIR 89-3920 (September 1989).

This bibliography lists publications by the staff of the National Institute of Standards and Technology's Electromagnetic Fields Division for the period from January 1970 through August 1989. Selected earlier publications from the Division's predecessor organizations are included.
[Contact: Kathryn A. Gibson, (303) 497-3132]

DeWeese, M.E., **Metrology for Electromagnetic Technology: A Bibliography of NIST Publications**, NISTIR 89-3921 (August 1989).

This bibliography lists the publications of the personnel of the Electromagnetic Technology Division of NIST in the period from January 1970 through publication of this report. A few earlier references that are directly related to the present work of the Division are included.
[Contact: Sarabeth Moynihan, (303) 497-3678]

Palla, J.C., and Meiselman, B., **Electrical and Electronic Metrology: A Bibliography of NIST Electricity Division's Publications**, NIST List of Publications 94 (January 1990).

This bibliography covers publications of the Electricity Division, Center for Electronics and Electrical Engineering, NIST, and of its predecessor sections for the period January 1968 to December 1989. A brief description of the Division's technical program is given in the introduction.
[Contact: Jenny C. Palla, (301) 975-2220]

Walters, E.J., **Semiconductor Measurement Technology, NBS List of Publications 72** [a bibliography of NBS publications concerning semiconductor measurement technology for the years 1962-1989] (March 1990).

This bibliography contains reports of work performed at the National Institute of Standards and Technology in the field of Semiconductor Measurement Technology in the period from 1962 through December 1989. An index by topic area and a list of authors are provided.
[Contact: E. Jane Walters, (301) 975-2050]

NEW CALIBRATION SERVICES OFFERED

The explosive growth of optical fiber use in the communications industry has resulted in a demand for calibration services. NIST's Boulder, Colorado, laboratory now offers **measurements of optical laser power and energy at wavelengths and power levels of interest to fiber optic producers and users.** Measurements are based on a standard reference instrument called the C-series calorimeter. An electrically calibrated pyroelectric radiometer (ECPR) is calibrated against the calorimeter and is then used to calibrate optical power meters at wavelengths of 850, 1300, and 1550 nm. To improve calibration capabilities, NIST is preparing test measurement systems for detector linearity, detector uniformity, and detector spectral responsivity. These systems should be available in 6 months. For a paper outlining NIST's optical power measurement capabilities, contact Fred McGehan, Div. 360, NIST, 325 Broadway, Boulder, Colorado 80303. For more information on calibration services, contact Thomas R. Scott, Div. 724, same address, or phone (303) 497-3651.

Additional Information (cont'd.)

NEW NIST RESEARCH MATERIAL

NIST has announced the availability of **Research Material 8458**, a well-characterized artificial flaw used as an **artifact standard in eddy current nondestructive evaluation (NDE)**. The new Research Material (RM) is the outcome of work carried out by the Division to address the need for calibration standards for eddy-current NDE, for example as used to detect fatigue cracks in aircraft structures. The RM flaw is produced in an annealed aluminum alloy block by first indenting the block and then compressively deforming the resulting notch until it is tightly closed. The next operation is to restore a flat finish to the block face, after which the block is heat treated to the original temper. The controlled flaw has been named the "CDF notch," after its inventors (listed on patent application) Thomas E. Capobianco (Electromagnetic Technology Division), William P. Dube (Division 583), and Ken Fizer (Naval Aviation Depot, NAS Norfolk, Virginia).

In the past, the challenge has been to manufacture artificial flaws that closely simulate the mechanical properties of fatigue cracks. Currently used artifacts include electrical-discharge-machined and saw-cut notches, both of which are relatively poor representations of fatigue cracks as their widths are too great. The Division-developed method provides notches that can be made controllably in a variety of geometries, have known dimensions, with widths that are narrow enough to provide an acceptable representation of fatigue cracks.

An NIST Research Material is not certified by NIST, but meets the International Standards Organization definition of "a material or substance one or more properties of which are sufficiently well established to be used in the calibration of an apparatus, the assessment of a measurement method, or for assigning values to materials." The documentation issued with RM 8458 is a "Report of Investigation." Contact: technical information -- Fred Fickett, (303) 497-3785; order information--Office of Standard Reference Materials, (301) 975-6776.

JAN. 1, 1990 CHANGES IN THE U.S. ELECTRICAL UNITS

Effective January 1, 1990, the U.S. as-maintained (i.e., "practical") units of voltage and resistance were increased by 9.264 ppm and 1.69 ppm, respectively. The increases in the U.S. legal units of current and of electrical power will be about 7.57 ppm and 16.84 ppm, respectively. These changes result from efforts by the major national standardizing laboratories, including the National Institute of Standards and Technology (NIST), formerly the National Bureau of Standards (NBS), to re-evaluate their as-maintained units in terms of the International System of Units (SI). The consequence of this activity has been the introduction of standards representing the SI units of voltage and resistance by the International Committee of Weights and Measures, an international body created by the Treaty of the Meter.[1] The use of these standards world-wide beginning January 1, 1990, will result in international consistency of electrical measurement as well as coherence among the practical units of length, mass, electricity, time, etc., inherent in the definitions of the SI.

Implementation of Changes at NIST

These changes have been instituted in

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[1] **Note that the SI Units have not been redefined; rather, they have been realized more accurately and a quantum physics representation of the ohm has been introduced, thus leading to the changes in magnitude of the practical or as-maintained units.**

Changes in U.S. Elec. Units (cont'd.)

the U.S. by NIST using the new, internationally-adopted constants $K_{J-90} = 483\ 597.9$ GHz/V exactly and $R_{K-90} = 25\ 812.807\ \Omega$ exactly with the Josephson and quantum Hall effects to establish representations of the SI volt and ohm, respectively. The representation of the SI volt is attained by using K_{J-90} in the formula

$$U_J(n) = \frac{f}{K_J} \qquad n = 1,2,3,\ldots$$

to give the voltages $U_J(n)$ of the steps produced by the ac Josephson effect at a frequency f. The past value, K_{J-72}, was 483 593.42 GHz/V(NBS-72), thus leading to the 9.264 ppm change. Likewise, R_{K-90} is used in the following formula for the resistance of the i^{th} plateau of a quantum Hall effect device,

$$R_H(i) = \frac{R_K}{i} \qquad (R_K = R_H(1))$$

to realize a representation of the SI ohm. The most recent past national unit of resistance, $\Omega(\text{NBS-48})_t$, was based on a group of five Thomas one-ohm standards and had an uncompensated drift rate of approximately -0.053 ppm per year. Since the quantum Hall effect is used as the national standard, the U.S. representation of the ohm has no drift. (The past unit of voltage, V(NBS-72), was based on the Josephson effect since 1972, and accordingly had a zero drift rate.)

Reassignments to Non-adjustable Standards

Since the U.S. practical volt and ohm units increased on January 1, 1990, the changes must be implemented in non-adjustable standards calibrated in terms of V(NBS-72) and/or Ω(NBS-48) only by reducing the values assigned to them proportionally. The examples given below show how to do this for a standard cell and a standard resistor.

Sample Adjustments of Values of Standards

Standard cell:

"Old" emf 1.0180564 V(NBS-72)

Multiply "Old" emf by 0.999990736 to get emf in terms of the present volt representation 1.01804697 ≈ 1.0180470 V

Standard resistor:

"Old" resistance value
$9999.976\ \Omega(\text{NBS-48})_{01/01/90}$

Multiply "Old" resistance by 0.99999831 to get the resistance in terms of the present ohm representation
9999.9591 ≈ 9999.959 Ω

In the above, "Old" refers to the value of the standard which would have been in use on January 1, 1990, had the changes not been made; i.e., if a correction curve based on its past assigned values has been employed to obtain the currently-used value for a standard, the above represents a downward shift of the curve starting January 1, 1990. For resistance, the slope of the curve also changed (slightly) since Ω(NBS-48) has a drift rate and Ω(NIST-90) does not.

Do not send your standards to NIST for recalibration on January 1, 1990, unless they are normally due then. The changes are accurately known and corrections to existing standards may be applied.

Adjustment of Instrumentation

An assigned or calibrated value of a standard is merely a label giving the magnitude of the parameter embodied in the standard. The actual emf or resistance of a standard did not change on January 1, 1990; only what it is called should have changed. In the same sense, meter readings are labels giving the magnitudes of the parameters being measured. **Readings taken after January**

Changes in U.S. Elec. Units (cont'd.)

1, 1990 using unadjusted meters will be too large in magnitude. Adjustments to meters must have the effect of reducing the amplitudes of readings for fixed emf's or resistances.

Adjustable voltage and current sources or adjustable resistors for which nominal output is desired, on the other hand, must have their outputs increased proportionally by the above amounts. DVM calibrators are probably the largest class of this type of instrument.

Guidelines

The National Conference of Standards Laboratories (NCSL) and NIST have formed NCSL ad hoc Committee 91.4, Changes in the Volt and Ohm to assist industry and government laboratories in coming into compliance with the changes. A major responsibility of the committee is the generation and publication of a set of guidelines which describes unambiguous methods for adjusting standards and instruments, or their values, and delineates other types of problems which may arise, e.g., voltage values called out explicitly in maintenance procedures, values imbedded in software, and the like. These guidelines have been published as NIST Technical Note 1263, "Guidelines for Implementing the New Representations of the Volt and Ohm Effective January 1, 1990." This document is available at no charge through the NIST Electricity Division. To receive a copy, contact Sharon Fromm at 301-975-4222.

For further information, contact Norman B. Belecki (301-975-4223), Ronald F. Dziuba (301-975-4239), Bruce F. Field (301-975-4230), or Barry N. Taylor (301-975-4220).

U.S. REPRESENTATIONS OF ELECTRICAL POWER AND ENERGY

Watt, Var, Volt-Ampere
Joule, Watthour, Varhour
Volt-Ampere-hour, and Q-hour

Background

By international agreement, starting on January 1, 1990, the U.S. put into place new representations of the volt and ohm based, respectively, on the Josephson and Quantum Hall effects and which are highly consistent with the International Systems of Units (SI). Implementation of the new volt and ohm representations in the U.S. required that on January 1, 1990, the value of the present national volt representation maintained by the National Institute of Standards and Technology (NIST, formerly the National Bureau of Standards) be increased by 9.264 parts per million (ppm) and that the value of the national ohm representation be increased by 1.69 ppm (1 ppm = 0.0001%). The resulting increase in the national representation of the ampere is 7.57 ppm. The resulting increase in the national representations of the electrical quantities of power, namely the watt, var, and volt-ampere, and the quantities of energy, namely the joule, watthour, varhour, volt-ampere-hour, and Q-hour is 16.84 ppm.

The adjustment for electrical power and energy is generally very small compared to revenue metering measurement uncertainties (typically greater than ±0.1%) and therefore are not likely to have a significant effect. Adjustments do not need to be applied in the above instances. However, for the highest accuracy calibrations of power and energy standards having uncertainties less than ±0.020%, adjustments should be made. Accordingly, all Reports of Calibration and Reports of Test issued by NIST after January 1, 1990, reflect the appropriate changes.

For instruments calibrated prior to January 1, 1990, adjustments to the calibration values due to the change in the volt and ohm can be made without instrument recalibration. The adjustments are exact and, if properly applied, will not introduce any errors.

Electrical Power & Energy (cont'd.)

Examples given below will illustrate proper procedures for applying the new adjustments.

Adjustments for Wattmeters, Varmeters, and Volt-Ampere Meters

Calibrations of wattmeters, varmeters, and volt-ampere meters at NIST provide customers with corrections and uncertainties given in units of watts, vars, or volt-amperes, as appropriate. Applying the appropriate adjustment due to the new representations of the volt and ohm for power measuring instruments (i.e., wattmeters for "real power" and varmeters for quadrature or imaginary power) requires minor calculations. First, it is necessary to assess the magnitude of the calibration uncertainty in percent and then decide if applying adjustments for the change in the volt and ohm are required. To determine the percentage uncertainty, simply divide the uncertainty in watts, vars, or volt-amperes by the product of the applied voltage and current times the power factor (the real power) and multiply that quantity by 100, as

$$U\% = [(U_w,\ U_v,\ \text{or}\ U_va)/(V_a \times I_a \times PF)] \times 100,$$

where

$U\%$ is the uncertainty in percent,
U_w is the calibration uncertainty in watts,
U_v is the calibration uncertainty in vars,
V_{va} is the calibration uncertainty in volt-amperes,
V_a is the applied voltage in volts,
I_a is the applied current in amperes, and
PF is the power factor (including its sign).

For example, if the uncertainty is stated on a Report of Calibration as ±0.060 watts for the calibration of a wattmeter at an applied voltage of 120 V and an applied current of 5 A at unity power factor, then

$$\text{Percent Uncertainty} = U\% = [(\pm 0.060\ \text{W})/(120\ \text{V} \times 5\ \text{A} \times 1)] \times 100 = \pm 0.010\%.$$

If the percentage uncertainty, as calculated above, is less than ±0.020%, (as it is in the above example), then it is recommended that an adjustment of 0.0017% (0.001684% rounded to four significant decimal places) due to the new representations of the volt and ohm be applied.

The second step is the calculation of how large the adjustment will be (in units of watts, vars, or volt-amperes, as appropriate), due to the reassignment of the volt and ohm. For the same example given above, if the calibration correction was given in a Report of Calibration as +0.052 watts, then the adjustment due to the change in the volt and ohm may be calculated by multiplying the product of the applied voltage and current times the power factor by 0.000017 (0.0017% expressed in proportional parts), as

$$\text{Adjustment} = (V_a \times I_a \times PF) \times 0.000017$$
$$\text{Adjustment} = (120\ \text{V} \times 5\ \text{A} \times 1\ ) \times 0.000017 = 0.010\ \text{watts}.$$

The resulting product should be rounded to the same number of significant decimal places as the old calibration correction was given. This result is then subtracted from the old calibration correction, as in the following example:

Old Calibration Correction
(prior to 1/1/90) = {+0.052 watts}
less 0.000017 x Applied
Volt-amperes x PF = -{+0.010 watts}
New Calibration Correction
(after 1/1/90) = {+0.042 watts}

If the old calibration correction (prior to 1/1/90) at test conditions of 120 V, 5 A, and at a power factor of 0.5 lag, happened to be a negative quantity, for example, -0.031 watts, then the old

Electrical Power & Energy (cont'd.)

calibrations correction would be decreased (made more negative) by 0.0017% of the applied volt-ampere product times the power factor, as in the following example:

Old Calibration Correction
(prior to 1/1/90) = (-0.031 watts)
less 0.000017 x Applied
Volt-amperes x PF = -(+0.005 watts)
New Calibration Correction
(after 1/1/90) = (-0.036 watts)

The process of making the corresponding change for the varmeter corrections is identical to that show above. For volt-ampere meters, the adjustment is made independent of the power factor (i.e., a value of PF = 1 may be used). However, most varmeter and volt-ampere meter calibrations have stated uncertainties greater than ±0.020%, and hence, would not require an adjustment.

Adjustments for Joule, Watt-, Var-, Volt-Ampere- and Q-Hour Meters

Applying adjustments to electric energy measuring instruments (i.e., joule, watthour, varhour, volt-ampere-hour, and Q-hour meters) for changes in the representation of the volt and ohm, is more straightforward because the common calibration constant for energy metering is expressed as a "percentage registration." The amount the registration is to be adjusted can be subtracted directly as a percentage, regardless of power factor.

For example, if a watthour meter has a registration of 100.015% before January 1, 1990, then after that date, the new assigned registration would be decreased by 0.0017% (rounded from 0.001684%) as

Old percentage registration
(prior to 1/1/90) = 100.015%
less amount due to change
in volt and ohm = -0.0017%
New percentage registration
(after 1/1/90) = 100.0133%

Rounded to three significant
decimal places = 100.013%

The process of making the corresponding changes for the joule, varhour, volt-ampere-hour and Q-hour meters are identical to that shown above. If the associated uncertainty of the calibration is greater than ±0.020%, no adjustments are necessary, as stated in the instances for wattmeters, varmeters, and volt-ampere meters. The uncertainties for varhour, volt-ampere-hour, and Q-hour meters are seldom less than ±0.020%, and hence adjustments generally do not need to be made.

Reference

N. B. Belecki, R. F. Dziuba, B. F. Field, and B. N. Taylor, Guidelines for Implementing the New Representations of the Volt and Ohm Effective January 1, 1990, NIST Tech. Note 1263, June, 1989.

Copies of the above document are available at no cost from:

National Institute of Standards and Technology
Electricity Division, MET B146
Gaithersburg, MD 20899
Telephone: (301) 975-4222

For Further Information

For further information concerning the above information, contact either John D. Ramboz (301) 975-2434 or Thomas L. Nelson (310) 975-2427, or write:

National Institute of Standards and Technology
Electricity Division, MET B344
Gaithersburg, MD 20899

NEW BROCHURE FOR SEMICONDUCTOR SRMs

Standard Reference Materials for Semiconductor Manufacturing Technology lists a series of SRMs for use in characterizing semiconductor materials and processes. The SRMs include a series of silicon resistivity materials

New Brochure (cont'd.)

for calibrating four-probe and eddy-current test equipment, sizing materials for calibrating optical and scanning electron microscopes, SRMs for mechanical testing, optical measurements, X-ray and photographic films, X-ray diffraction, and the chemical analysis of materials.
[Contact: Office of Standard Reference Materials, Cindy Leonard, (301) 975-2023]

1990 CEEE CALENDAR

September 11-12, 1990 (Boulder, CO)

Symposium on Optical Fiber Measurements. NIST, in cooperation with the Institute of Electrical and Electronics Engineers Optical Communications Committee and the Optical Society of America, will sponsor the 6th biennial Symposium on Optical Fiber Measurements. The symposium will be devoted entirely to measurements on fiber, related components, and systems. Typical topics will include telecommunications fibers, fiber lasers and amplifiers, fibers for sensors, couplers, connectors, multiplexers, integrated optics, sources, detectors, modulators, switches, long haul systems, LANs, subscriber loops, field and laboratory instrumentation, and standards. Experimental and analytical papers are solicited on any aspect of measurements for guided-lightwave technology. Those who wish to present a paper must submit a summary by May 31, 1990 to: Gordon W. Day, Program Chairman, Symposium on Optical Fiber Measurements, NIST, Div. 724.02, Boulder, Colo. 80303-3328. For more information, contact the General Chairman, Douglas L. Franzen, at the same address, or call 303/497-3346.

September 17-19, 1990 (Boston, MA)

VLSI and GaAs Chip Packaging Workshop. The IEEE CHMT Society and the National Institute of Standards and Technology are co-sponsoring the Ninth VLSI packaging Workshop. Topics to be discussed include VLSI package design; multichip module design; WSI packaging; package thermal design; package electrical design; GaAs IC packaging; VLSI package interconnection options; VLSI package materials and die-attach solutions; and failure mechanism and quality of VLSI packages. All attendees are expected to be specialists working in the field and to participate in discussions.
[Contact: George G. Harman, (301) 975-2097]

October 24-26 (Boulder, CO)

Symposium on Optical Materials for High Power Lasers (Boulder Damage Symposium). The Symposium is the principal forum for the exchange of information on the physics and technology of materials for high-power lasers. Co-sponsors in addition to NIST are ASTM -- Standards for Materials, Products, Systems & Services; the Center for Research in Electro-Optics and Lasers at the University of Central Florida; the Defense Advanced Research Projects Agency; Lawrence Livermore National Laboratory, Los Alamos National Laboratory; SPIE -- the International Society for Optical Engineering; and the Weapons Laboratory of the U.S. Air Force. Topics on the agenda include new materials, bulk damage phenomena, surface and thin-film damage, preparation of optical material, measurement of optical material properties, design consideration for high-power systems, and fundamental mechanisms of laser-induced damage.
[Contact: Aaron A. Sanders, (303) 497-5341]

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This is the twenty-fourth issue of a quarterly publication providing information on the technical work of the National Institute of Standards and Technology (formerly the National Bureau of Standards) Center for Electronics and Electrical Engineering. This issue of the Center for Electronics and Electrical Engineering Technical Publication Announcements covers the first quarter of calendar year 1990. Abstracts are provided by technical area for papers published this quarter.

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antennas; electrical engineering; electrical power; electromagnetic interference; electronics; instrumentation; laser; magnetics; microwave; optical fibers; semiconductors; superconductors

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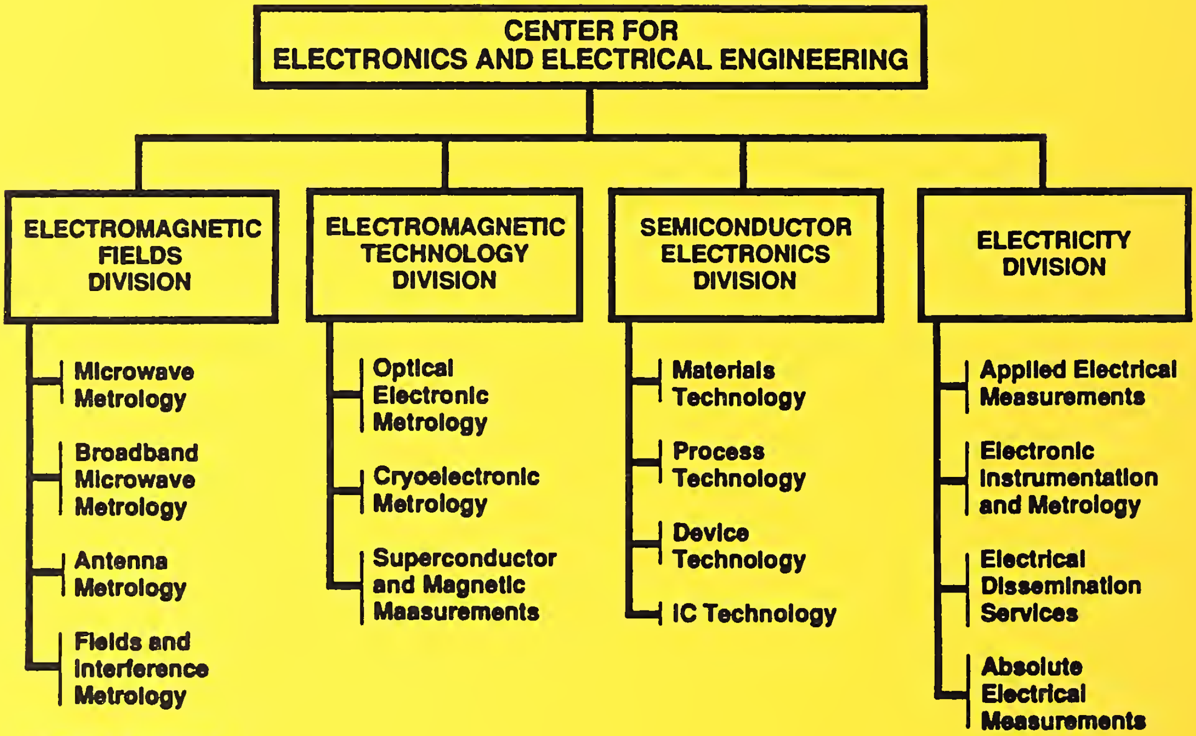

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KEY CONTACTS

Center Headquarters (720)	Director, Mr. Judson C. French (301) 975-2220
	Deputy Director, Mr. Robert I. Scace (301) 975-2220
Electromagnetic Fields Division (723)	Chief, Dr. Ramon C. Baird (303) 497-3131
Electromagnetic Technology Division (724)	Chief, Dr. Robert A. Kamper (303) 497-3535
Semiconductor Electronics Division (727)	Chief, Mr. Frank F. Oettinger (301) 975-2054
Electricity Division (728)	Chief, Dr. Oskars Petersons (301) 975-2400

INFORMATION:

For additional information on the Center for Electronics and Electrical Engineering, write or call:

Center for Electronics and Electrical Engineering
National Institute of Standards and Technology
Metrology Building, Room B-358
Gaithersburg, MD 20899
Telephone (301) 975-2220