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Center for Electronics and Electrical Engineering

Technical Publication Announcements

Covering Center Programs,
April to June 1988,
with 1988 CEEE Events Calendar

17

November 1988

U.S. Department of Commerce
National Institute of Standards and Technology
National Engineering Laboratory
Gaithersburg, Maryland 20899

INTRODUCTION TO THE CEEE TECHNICAL PUBLICATION ANNOUNCEMENTS

This is the seventeenth 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 second quarter of calendar year 1988.

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 1988 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 Electrosystems Division in Gaithersburg and the Electromagnetic Fields and Electromagnetic Technology Divisions in Boulder, CO. See the table of contents on the opposite page for identification of the topics covered by each program, as represented in this issue. 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 10.

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 8.

TABLE OF CONTENTS

SEMICONDUCTOR TECHNOLOGY

Dimensional Metrology

Postek, M.T., Keery, W.J., and Larrabee, R.D., **The Relationship Between Accelerating Voltage and Electron Detection Modes to Linewidth Measurement in an SEM**, Journal of Scanning Microscopy, Vol. 10, pp. 10-18 (1988).

The basic premise underlying the use of the scanning electron microscope (SEM) for linewidth metrology in semiconductor research and production applications is that the video image acquired, displayed, analyzed, and ultimately measured accurately reflects the structure of interest. However, it has been clearly demonstrated that image distortions can be caused by the detected secondary electrons not originating at the point of impact of the primary electron beam and by the type and location of the secondary electron detector. These effects and their contributions to the actual image or linewidth measurement have not been fully evaluated. Effects due to uncertainties in the actual location of electron origination do not affect pitch (line center-to-center or similar-edge-location-to-similar-edge-location spacing) measurements as long as the lines have the same edge geometries and similar profiles of their images in the SEM. However, in linewidth measurement applications, the effects of edge location uncertainty are additive and thus give twice the edge detection error to the measured width. The basic intent of this work is to demonstrate the magnitude of the errors introduced by beam/specimen interactions and the mode of signal detection at a variety of beam acceleration voltages and to discuss their relationship to precise and accurate metrology.
[Contact: Michael T. Postek, (301) 975-2299]

Power Devices

Hefner, A.R., Blackburn, D.L., and Galloway, K.F., **A Steady-State Model for the Insulated Gate Bipolar Transistor**, Physics of Semiconductor Devices (Proceedings of the Fourth International Workshop, Madras, India, December 10-15, 1987), S.C. Jain and S. Radhakrishna, Eds. (World Scientific, Singapore, 1988), pp. 22-38.

The power Insulated Gate Bipolar Transistor (IGBT) is a switching device designed to overcome the high on-state loss of the power MOSFET. The IGBT behaves as a bipolar transistor which is supplied base current by a MOSFET. The bipolar transistor of the IGBT has a wide base with the base contact at the collector edge of the base and is operated with its base in high-level injection. The usual bipolar transistor models are not adequate for the IGBT. This paper describes a model for the IGBT developed using ambipolar transport.
[Contact: Allen R. Hefner, (301) 975-2071]

Insulators and Interfaces

Carver, G.P., Kopanski, J.J., Novotny, D.B., and Forman, R.A., **Specific Contact Resistivity of Metal-Semiconductor Contacts -- A New, Accurate Method Linked to Spreading Resistance**, IEEE Transactions on Electron Devices, Vol. 35, No. 4, pp. 489-497 (April 1988).

A new method to deduce the specific contact resistivity of metal-semiconductor contacts has been developed that allows separation of the components contributing to the total series resistance between two contacts. The principle of the method is the subtraction of the semiconductor spreading resistance, deduced from a four-contact resistivity measurement, from the total two-contact resistance. This procedure requires geometrically well-defined small contacts that are accurately fabricated by lithographic methods. Using the method, accurate values were obtained for the specific contact

Insulators and Interfaces (cont'd.)

resistivity of an aluminum-1.5% silicon alloy to p-type silicon wafers having dopant densities from 5 x 10^{14} to 2 x 10^{20} cm^{-3}. The specific contact resistivity values are lower than previously published values obtained using earlier methods in which parasitic and nonideal effects could not be quantified or eliminated. The lower values indicate that contact resistance has a less limiting effect on the performance of integrated circuits than presently believed.
[Contact: Joseph J. Kopanski, (301) 975-2089]

FAST SIGNAL ACQUISITION, PROCESSING, AND TRANSMISSION

Waveform Metrology

Lawton, R.A., and Anderson, W.T., **Two-Layer Dielectric Microstrip Line Structure: SiO_2 on Si and GaAs on Si: Modeling and Measurement**, IEEE Transactions on Microwave Theory and Techniques, Vol. 36, No. 4, pp. 785-789 (April 1988).

Further development of the modeling of the two-layer dielectric stripline structure is reported by computing the scattering parameter S_{21} derived from the model and comparing the computed value with the measured value over the frequency range from 45 MHz to 25 GHz. The sensitivity of S_{21} to various parameters of the structure is also discussed. Examples of measurement and modeling of the silicon dioxide on silicon system and modeling of the gallium arsenide on silicon system are given.
[Contact: William L. Gans, (303) 497-3538]

Cryoelectronic Metrology

Go, D., Hamilton, D., Lloyd, F.L., DiIorio, M.S., and Withers, R.S., **A Superconducting Analog Track-and-Hold Circuit**, IEEE Transactions on Electron Devices, Vol. 35, No. 4, pp. 498-501 (April 1988).

A superconducting analog track-and-hold circuit has been designed, fabricated, and tested. Experimental results demonstrate a 1.2-GHz bandwidth and a 25-dB dynamic range. Model calculations indicate that an optimized circuit with a critical current density of 10,000 A/cm^2 can achieve a 4-GHz bandwidth and a 35-dB dynamic range.
[Contact: Diane Go, (303) 497-3770]

Antenna Metrology

Muth, L.A., **Displacement Errors in Antenna Near-Field Measurements and Their Effect on the Far Field**, IEEE Transactions on Antennas and Propagation, Vol. 36, No. 5, pp. 581-591 (May 1988).

The effects of probe displacement errors in the near-field measurement procedure on the far-field spectrum are studied. Expressions are derived for the displacement error functions that maximize the fractional error in the spectrum both for the on-axis and off-axis directions. The x-y and z-displacement errors in planar scanning are studied first, and the results are then generalized to errors in spherical scanning. Some simple near-field models are used to obtain order-of-magnitude estimates for the fractional error as a function of relevant scale lengths of the near field, defined as the lengths over which significant variations occur.
[Contact: Lorant A. Muth, (303) 497-3603]

Microwave & Millimeter-Wave Metrology

Hoer, C.A., **An Equivalent Circuit for Imperfect Transmission Line Connectors**, Digest of the 1988 Conference on Precision Electromagnetic Measurements, Tsukuba, Japan, June 7-10, 1988, pp. 264-265.

An exact equivalent circuit for a pair of transmission line connectors is

Microwave & Millimeter-Wave (cont'd.)

developed. New reference planes are chosen in such a way that all imperfections in the connector pair can be lumped into one connector or the other. This makes it possible to compensate for imperfections in test port connectors when calibrating network analyzers.
[Contact: Cletus A. Hoer, (303) 497-3705]

Holt, D.R., **Determination of Scattering Parameters from Precision Coaxial Air-Line Standards**, Digest of the 1988 Conference on Precision Electromagnetic Measurements, Tsukuba, Japan, June 7-10, 1988, p. 263.

Scattering parameter expressions are developed for the principal mode of a coaxial air line. Dimensional variations in the inner and outer conductors and skin effect are included in the model. An error analysis reveals that accuracy of the scattering parameters is primarily dependent on the precision of the measurements of conductor radii.
[Contact: Donald R. Holt, (303) 497-3574]

ELECTRICAL SYSTEMS

Power Systems Metrology

Van Brunt, R.J., and Kulkarni, S.V., **New Method for Measuring the Stochastic Properties of Corona and Partial Discharge Pulses**, Conference Record of the 1988 IEEE International Symposium on Electrical Insulation, Boston, Massachusetts, June 7, 1988, pp. 233-237.

A new computer-based method for measuring the statistical characteristics of corona or partial discharge pulses is described. The method allows direct measurement of a set of conditional probability distributions that reveal correlations among successive pulse amplitudes, pulse time intervals, and between pulse amplitudes and time intervals. Application of the method to an investigation of ultraviolet sustained negative corona (Trichel) pulses in air has shown the existence of strong correlations between pulse amplitude and time interval as well as between amplitudes of successive pulses. The observed correlations appear to be consistent with existing models for Trichel pulse formation.
[Contact: Richard J. Van Brunt, (301) 975-2425]

Superconductors

Ekin, J.W., Panson, A.J., and Blankenship, B.A., **Effect of Oxygen Annealing on Low-Resistivity Contact for High-T_c Superconductors**, Proceedings of the Materials Research Society 1988 Spring Meeting, Symposium K, Reno, Nevada, April 5-8, 1988, Vol. 99, pp. 283-286.

A method for making low-resistivity contacts to high-T_c superconductors has been developed, consisting of depositing noble metal contact pads (silver or gold) on a clean superconductor surface at low temperatures (<150°C). After annealing the silver contact pads in oxygen at intermediate temperatures (≤500°C) for 1 h, contact resistivities less than 2×10^{-8} Ω-cm^2 at 76 K are obtained, about six orders of magnitude less than for indium-solder contacts. Before annealing, the contact resistivities are still very low, in the 10^{-6} to 10^{-5} Ω-cm^2 range at 76 K, which would be useful when contacts with low fabrication temperatures are required. The voltage-current characteristics of the contacts are strongly nonlinear after annealing, having a superconducting transition character. This is ascribed to the critical current of the superconducting material being exceeded at the contact interface. External connections to the contact pads have been made using both solder and thermosonic wire-bonding techniques.
[Contact: John W. Ekin, (303) 497-5448]

Goodrich, L.F., **Development of Standards for Superconductors**, NBSIR 88-3088 (February 1988).

Superconductors (cont'd.)

A cooperative program with the Department of Energy, the National Bureau of Standards, other national laboratories, and private industry is in progress to develop standard measurement practices for use in large-scale applications of superconductivity. Research for the period January 1986 through December 1987 is described. This report contains the results of critical-current studies on the effect of power supply current ripple, measurements on single strands extracted from cables, a round robin on a large NbTi monolithic conductor, and a Nb_3Sn round robin. Several useful current supply circuits have been developed. The reduction coupling losses in multifilamentary NbTi conductors have been addressed by a study of the magnetic properties of matrix material consisting of dilute alloys of Mn in Cu. In addition, the technique of vibrating-sample magnetometry is shown to be adaptable to the measurement of coupling losses in addition to hysteresis losses in multifilamentary conductors.
[Contact: Loren F. Goodrich, (303) 497-3143]

Goodrich, L.F., Bray, S.L., and Clark, A.F., **Current-Ripple Effect on Superconductive dc Critical-Current Measurements**, Advances in Cryogenic Engineering Materials, Vol. 34, pp. 1019-1026 (1988).

The effect of current ripple or noise on dc critical-current measurements was systematically studied. Measurements were made on multifilamentary NbTi superconductors. A low-noise, battery-powered current supply was required in this study in order to make the pure dc critical-current measurements. Also, an electronic circuit that simulates a superconductor's general current-voltage characteristic was developed and used as an analysis tool. In order to make critical-current measurements in which current ripple was present, the battery supply was modified to allow the introduction of controlled amounts of ac ripple. In general, ripple in a current supply becomes more significant above 500 A, because effective filtering is difficult. The effect of current ripple is a reduction in the measured dc critical current; however, ripple of sufficient amplitude can result in arbitrary measurement results. The results of this work are general and quantitatively applicable to the evaluation of critical-current data and measurement systems. A theoretical model was developed to further support and explain the ripple effect. An unexpected benefit of this work was that it led to a more precise method for general critical-current data acquisition. Problems common to all large-conductor critical-current measurements are discussed.
[Contact: Loren F. Goodrich, (303) 497-3143]

Magnetic Materials & Measurements

Fickett, F.R., **Transverse Magnetoresistance of Oxygen-Free Copper**, IEEE Transactions on Magnetics, Vol. 24, No. 2, pp. 1156-1158 (March 1988).

Recent studies on the magnetoresistance of copper with residual resistance ratios (RRR) in the range 100 to 1000 using cold work and irradiation as parameters modifying RRR show a large spread in the appropriate region of the Kohler plot. This spread is much larger than that found in our earlier work on very pure copper in which we used temperature as the main variable. We report results of 4-K magnetoresistance measurements on a large number of samples of copper from various sources and in various states of cold work, strain, and reanneal. A new look is taken at the Kohler plot as a method for predicting magnetoresistive behavior.
[Contact: Frederick R. Fickett, (303) 497-3785]

Other Electrical Systems Topics

Mopsik, F.I., Kelley, E.F., and Martz-

Other Electrical Systems (cont'd.)

loff, F.D., **A Review of Candidate Methods for Detecting Incipient Defects Due to Aging of Installed Cables in Nuclear Power Plants**, 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

Hill, D.A., **A Circular Array for Plane-Wave Synthesis**, IEEE Transactions on Electromagnetic Compatibility, Vol. 30, No. 1, pp. 3-8 (February 1988).

We analyze a circular array of electric line sources for generating a uniform plane wave in the interior region of the array. Identical results for the synthesized element weightings are obtained using matrix inversion or a Fourier series technique. A physical optics approximation for the element weightings is also presented, but it yields a much poorer result for the synthesized field. The angle of arrival of the plane wave can be scanned by recalculating the element weightings, and the quality of the field is maintained. Frequency scanning is also possible, but the number of array elements limits the maximum frequency.
[Contact: David A. Hill, (303) 497-3472]

Kanda, M., and Driver, L.D., **An Optically Linked Electric and Magnetic Field Sensor for Poynting Vector Measurements in the Near Field of Radiating Sources**, Digest of the 1988 Conference on Precision Electromagnetic Measurements, Tsukuba, Japan, June 7-10, 1988, pp. 32-33.

An improved, single-element antenna-sensing technique is described which can simultaneously measure the electric (E) field, magnetic (H) field, and time-dependent Poynting vector of electromagnetic (EM) fields. Two radio-frequency voltages are produced which, along with relative phase and frequency information, are transmitted to a remotely located vector analyzer by a pair of matched fiber optic downlinks.
[Contact: Motohisa Kanda, (303) 497-5320]

Ma, M.T., **Theory and Measurements of Unintentional Radiators**, Digest of the 1988 Conference on Precision Electromagnetic Measurements, Tsukuba, Japan, June 7-10, 1988, pp. 30-31.

By characterizing an unknown emitter with equivalent vector electric- and magnetic-dipole moments, we formulate a theoretical basis to express the radiation properties of such an emitter in terms of these unknown dipole moments. Power and relative phase measurements from appropriate ports of a transverse electromagnetic cell, when the emitter is placed at the cell's center, are proven to be sufficient to determine quantitatively the unknowns and, therefore, the radiation characteristics.
[Contact: Mark T. Ma, (303) 497-3800]

Randa, J.P., Kanda, M., Melquist, D.G., Sega, R.M., and Norgard, J.D., **High Frequency Electric-Field Probe Development**, Proceedings of the International Conference on Electromagnetic Compatibility (EMC EXPO'88), Washington, D.C., May 10-12, 1988, pp. T15.31-

Radiated EMI (cont'd.)

T15.37.

Various designs have been considered for electric-field probes for the frequency range 26 to 110 GHz. A fiber optic temperature sensor to detect the heating of a resistive strip was designed, built, and tested. With increased sensitivity, this design may be capable of operating to above 100 GHz.
[Contact: James P. Randa, (303) 497-3150]

Vanzura, E.J., **Automated System for Electromagnetic Field Generation and Immunity Testing**, Proceedings of the 1988 IEEE Instrumentation/Measurement Technology Conference, San Diego, California, April 19-22, 1988, pp. 3-10.

An interactive computer-controlled system has been constructed for radiated immunity measurements. It can set up a desired unperturbed field strength at a point in space and simultaneously measure field strengths and polarizations at up to ten different positions. Field mapping experiments have been performed with the system in an anechoic chamber, a partially loaded shielded room, and an unloaded shielded room. Results confirm dramatic improvement in spatial field uniformity as more absorber is used. If the unperturbed fields in a specified test volume do not deviate more than a desired amount for any frequency of interest, meaningful immunity tests can be performed. An equipment under test is placed into the test volume and its response to radiation is measured using current probes and a spectrum analyzer. Such an experiment requires many mid-experiment calculations, making automation highly desirable because of significant time savings.

Our frequency range of interest is 50 to 200 MHz because this is a particularly difficult frequency band in which to perform reliable immunity tests. By measuring the field variations in a test zone, systematic uncertainty limits due to spatial field deviations can be estimated more accurately. This allows testing in an anechoic chamber below what is normally considered its lowest usable frequency. If an anechoic chamber is not available, a partially loaded shielded room can be used, with the necessary requirement that specifications on spatial field uniformity be relaxed.

This measurement system can be used in conjunction with many other facilities, such as a tranverse electromagnetic cell, an open-field site (ground screen) or a reverberating chamber, and can be used to test at frequencies from the low kilohertz up to 2 GHz.
[Contact: Eric J. Vanzura, (303) 497-5752]

Vanzura, E.J., and Adams, J.W., **Electromagnetic Fields in Loaded Shielded Rooms**, Test and Measurement World, pp. 72ff (November 1987).

This paper describes a computer-controlled feedback system that can maintain field strength levels within moderate bounds inside a partially loaded shielded room. These levels are relatively uniform over a large enough volume to allow radiated immunity testing of moderate-sized objects. The frequency range depends on the characteristics of the transmit antenna; we used 50 to 200 MHz, which is a difficult range to cover because of limitations of other EMC susceptibility test facilities.

The measurement system consists of a computer, signal generator, amplifier, biconical antenna, and an isotropic probe system.
[Contact: Eric J. Vanzura, (303) 497-5752]

Wilson, P.F., **A Comparison Between Near-Field Shielding-Effectiveness Measurements Based on Coaxial Dipoles and on**

Radiated EMI (cont'd.)

Electrically Small Apertures, IEEE Transactions on Electromagnetic Compatibility, Vol. 30, No. 1, pp. 23-28 (February 1988).

The near-field shielding effectiveness of a material may be measured by placing it between two closely spaced dipoles (electric or magnetic) and noting the resulting insertion loss. An alternative approach is to cover an electrically small aperture with the test material and to measure the resulting loaded aperture polarizability (electric or magnetic), as is done in a dual TEM cell. Expressions are developed herein which relate these two configurations.
[Contact: Perry F. Wilson, (303) 497-3842]

Wu, D.I., and Chang, D.C., **The Effect of a Large Rotating Scatterer in a Rectangular Cavity**, NBS Technical Note 1317 (March 1988).

In a mode-stirred chamber, the field in the cavity is perturbed with a stirrer, i.e., a rotating scatterer, in such a way that it is uniformly random. In this report, we investigate the key factor which governs the effectiveness of a stirrer. By examining the fundamental properties associated with a perturbing body in a cavity, we find that the key to effective field perturbation lies in the shifting of eigenmode frequencies. When the size of the perturbing body becomes large, the shifting may be large enough that the new perturbed modes no longer resemble the original unperturbed modes. In effect, as this body rotates, different perturbed modes may be excited, thus introducing randomness into the system. We illustrate this phenomenon by examining a 2D cavity with a 1D perturbing body. Using the transmission-line-matrix method, the shifting of eigenfrequencies and the variation on the magnitude of the fields for different stirrer sizes are computed. From this analysis, useful insights are drawn which include an analogy between the action of a large stirrer and a frequency modulator.
[Contact: Doris Wu, (303) 497-3214]

Conducted Electromagnetic Interference

Martzloff, F.D., and Levinson, L.M., **Surge-Protective Devices** [original title ... and Zinc Varistor Technology], in Electronic Ceramics--Properties, Devices, and Applications, L.M. Levinson, Ed., Chapter 5 (Marcel Dekker, Inc., New York, 1988), pp. 275-305.

A tutorial description of surge-protective devices and their applications and requirements is given, comparing the three basic technologies: crowbars, varistors, and avalanche diodes. The varistor material is described in detail from the electronic ceramics point of view. Thirty references are given.
[Contact: Francois D. Martzloff, (301) 975-2409]

ADDITIONAL INFORMATION

Lists of Publications

Gibson, K.A., Page, J.M., and Miller, C.K.S., **A Bibliography of the NBS Electromagnetic Fields Division Publications**, NBSIR 85-3040 (February 1986).

This bibliography lists publications of the National Bureau of Standards' Electromagnetic Fields Division for the period from January 1984 through September 1985, with selected earlier publications from the Division's predecessor organizations.
[Contact: Kathryn A. Gibson, (303) 497-3132]

Kline, K.E., and DeWeese, M.E., **Metrology for Electromagnetic Technology: A Bibliography of NBS Publications**, NBSIR 87-3074 (June 1987).

This bibliography lists the publications

Lists of Publications (cont'd.)

of the personnel of the Electromagnetic Technology Division of NBS in the period from January 1970 through December 1986. 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 NBS Electrosystems Division Publications, NBS List of Publications 94** (January 1988).

This bibliography covers publications of the Electrosystems Division, Center for Electronics and Electrical Engineering, NBS, and of its predecessor sections for the period January 1963 to January 1988. 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 1962-1987] (March 1988).

This bibliography contains reports of work performed at the National Bureau of Standards in the field of Semiconductor Measurement Technology in the period from 1962 through December 1987. An index by topic area and a list of authors are provided.
[Contact: E. Jane Walters, (301) 975-2050]

RECENTLY ISSUED STANDARD REFERENCE MATERIALS

The Semiconductor Electronics Division announces the release of a new Standard Reference Material (SRM) for **ellipsometrically derived thickness and refractive index of a silicon dioxide film on silicon**. Available for sale to the public through the NIST Office of Standard Reference Materials [for orders, (301) 975-6776], SRM 2530 is separately available for three oxide thicknesses: 50 nm (2530-1), 100 nm (2530-2), and 200 nm (2530-3).

This SRM was developed to respond to industry needs to evaluate the accuracy of ellipsometers, but may also be used as aid in the calibration of various other optical and mechanical thickness monitoring instruments.

Each SRM consists of a 76-mm (3-in.) diameter silicon wafer on which a uniform silicon dioxide layer was grown, patterned, and partially covered with chromium. The certified values were determined from measurements made using the highly accurate ellipsometer developed in the Division and are the ellipsometric parameters delta, Δ, and psi, ψ, at a wavelength of $\lambda = 632.8$ nm. The SRMs are also certified for the derived values of thickness and refractive index of its silicon dioxide layer determined by using a two-layer model consisting of a silicon dioxide layer on a thin silicon-rich oxide interlayer.
[Contact: George A. Candela, (301) 975-2086]

1988 CEEE CALENDAR

October 26-28, 1988 (Boulder, CO)

Twentieth Symposium on Optical Materials for High Power Lasers (Boulder Damage Symposium). In addition to the NIST, this symposium is sponsored by the American Society for Testing and Materials, the Air Force Office of Scientific Research, the Office of Naval Research, the Defense Advanced Research Projects Agency, and the Department of Energy. It serves as the principal forum for the exchange of information on the physics and technology of materials for high-power lasers. Topics to be discussed include new materials, bulk damage phenomena, surface and thin-film damage, design considerations for high-power systems, and fundamental mecha-

CEEE Calendar (cont'd.)

nisms of laser-induced damage. [Contact: Aaron A. Sanders, (303) 497-5341]

February 7-9, 1989 (San Diego, CA)

IEEE Semiconductor Thermal and Temperature Measurements Symposium. This fifth annual **SEMI-THERM** symposium is sponsored by the Components, Hybrids, and Manufacturing Technology Society of IEEE in cooperation with NIST and constitutes an international forum for the presentation of new developments relating to generation and removal of heat within semiconductor devices, measurement of device temperatures, and the simulation of device and system thermal behavior. Major SEMI-THERM topic areas include: thermal measurements; simulation, computation, and software; thermal characterization; and applications.

The program includes keynote speakers, technical presentations, tutorial sessions, workshops, and an exhibit. In addition, the Semiconductor Equipment and Materials Institute (SEMI) and the Joint Electron Devices Engineering Council (JEDEC) have scheduled in conjunction with SEMI-THERM several Standards Committee Task Force meetings, to which attendees are invited. [Contact: Frank F. Oettinger, (301) 975-2054]

June 12-15, 1989 (Gaithersburg, MD)

International Conference on Narrow Gap Semiconductors and Related Materials. Jointly sponsored by the National Institute of Standards and Technology along with the U.S. Air Force Office of Scientific Research, the American Physical Society, the U.S. Office of Naval Research, Texas Instruments, and the University of North Texas, this conference is the first in the narrow gap field since 1981. The scope of the conference includes such topics as crystal growth and new materials; two-dimensional physics; surfaces and interfaces; superlattices and heterostructures; transport; impurities and defects; optical properties; nonlinear optical effects; device physics; lattice properties; and hot or nonequilibrium carrier effects.
[Contact: David G. Seiler, (301) 975-2081]

September 11-13, 1989 (Garmisch-Partenkirchen, FDR)

VLSI and GaAs Chip Packaging Workshop. The IEEE CHMT Society and the National Institute of Standards and Technology are co-sponsoring the Eighth VLSI Packaging Workshop. Topics to be discussed include VLSI package design; integrated 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]

December 7-8, 1989 (Gaithersburg, MD)

Power Semiconductor Devices Workshop. [Contact: David L. Blackburn, (301) 975-2068]

CEEE SPONSORS

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NBS-114A (REV. 2-8C)

U.S. DEPT. OF COMM. BIBLIOGRAPHIC DATA SHEET (See instructions)	1. PUBLICATION OR REPORT NO. NISTIR 88-3895	2. Performing Organ. Report No.	3. Publication Date November 1988

4. TITLE AND SUBTITLE

Center for Electronics and Electrical Engineering Technical Publication Announcements Covering Center Programs, April to June 1988, with 1988 CEEE Events Calendar

5. AUTHOR(S)

E. J. Walters, compiler

6. PERFORMING ORGANIZATION *(If joint or other than NBS, see instructions)*

NATIONAL BUREAU OF STANDARDS
U.S. DEPARTMENT OF COMMERCE
GAITHERSBURG, MD 20899

7. Contract/Grant No.

8. Type of Report & Period Covered

Apr. - June 1988

9. SPONSORING ORGANIZATION NAME AND COMPLETE ADDRESS *(Street, City, State, ZIP)*

U.S. Department of Commerce
National Institute of Standards and Technology
National Engineering Laboratory
Center for Electronics and Electrical Engineering

10. SUPPLEMENTARY NOTES

☐ Document describes a computer program; SF-185, FIPS Software Summary, is attached.

11. ABSTRACT *(A 200-word or less factual summary of most significant information. If document includes a significant bibliography or literature survey, mention it here)*

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12. KEY WORDS *(Six to twelve entries; alphabetical order; capitalize only proper names; and separate key words by semicolons)*

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

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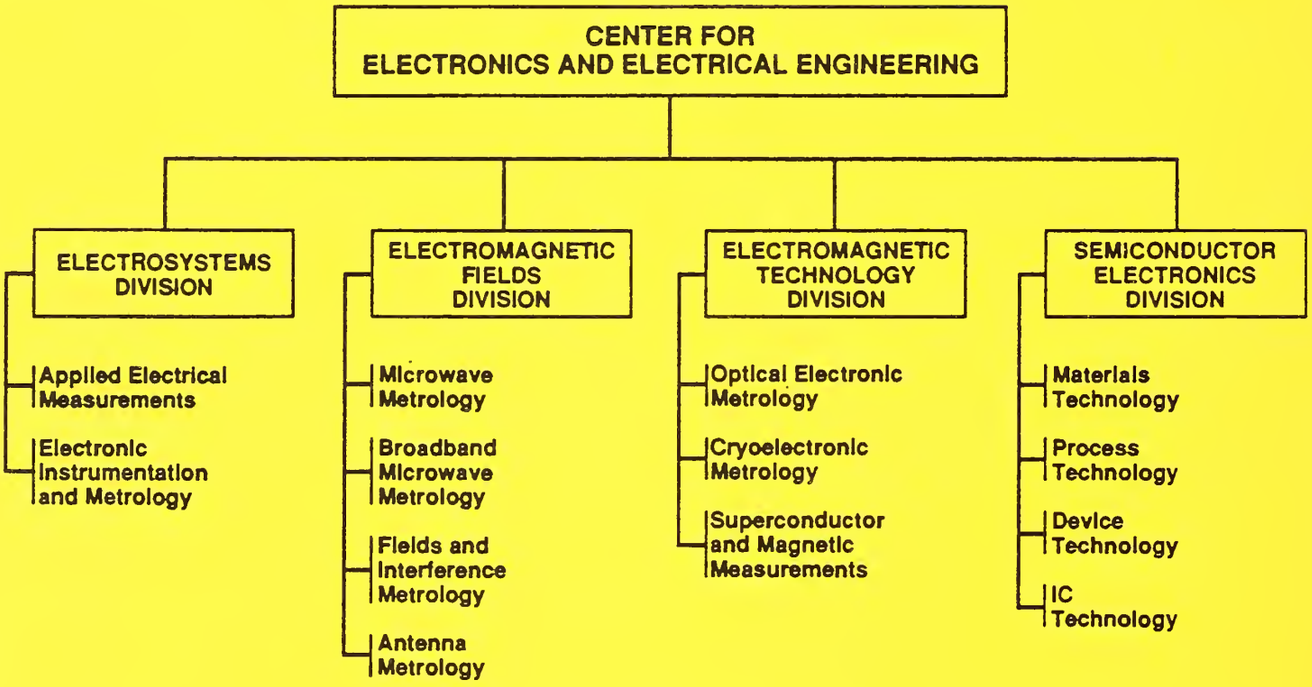

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