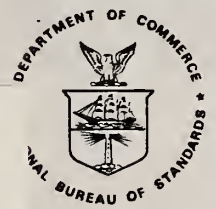
Center for Electronics and Electrical Engineering

Technical Publication Announcements

Covering Center Programs, July - September 1984 with 1985 CEEE Events Calendar

March 1985

U.S. Department of Commerce
National Bureau of Standards
National Engineering Laboratory
Gaithersburg, Maryland 20899



NBSIR 85-3106

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INTRODUCTION TO MARCH 1985 ISSUE OF THE CEEE TECHNICAL PUBLICATION ANNOUNCEMENTS

This is the second edition of a quarterly abstract journal covering the work of the National Bureau of Standards Center for Electronics and Electrical Engineering. This issue of the CEEE Technical Publication Announcements covers the third quarter of calendar year 1984.

Organization of Announcements: This issue contains citations and abstracts for Center papers published in the quarter. Entries are arranged by technical topic as identified in the table of contents and alphabetically by first author under each subheading within each topic. Following each abstract is the telephone number of the individual to contact for more information on the topic; unless otherwise noted, this person is the first author. This issue also includes a calendar of Center conferences and workshops planned for calendar year 1985, an announcement of newly released standard reference materials, 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 Materials and Processes and Semiconductor Devices and Circuits Divisions 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. 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 Bureau of Standards and a number of other organizations, in both the Federal and private sectors; these are identified on pages 7 and 8.

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 [publications from the Semiconductor Technology Program are covered in a single list, available from either Semiconductor Division].

TABLE OF CONTENTS

SEMICONDUCTOR TECHNOLOGY PROGRAM

Silicon Materials

Larrabee, R.D., Ed., **Neutron Transmutation Doping of Semiconductor Materials**, Proc. 4th Neutron Transmutation Doping Conference, June 2-3, 1982, Plenum Press, NY (1984).

This volume contains the papers presented at the Fourth International Neutron Transmutation Doping Conference held at the National Bureau of Standards in Gaithersburg, Maryland on June 1-3, 1982. The Fourth International Transmutation Doping Conference reported in this volume includes invited papers summarizing the present and anticipated future of NTD silicon, the processing and characterization of NTD silicon, and the use of NTD silicon in semiconductor power devices. In addition, four papers were presented on NTD of nonsilicon semiconductors, five papers on irradiation technology, three papers on practical utilization of NTD silicon, four papers on the characterization of NTD silicon, and five papers on neutron damage and annealing. These papers indicate that irradiation technology for NTD silicon and its use by the power-device industry are approaching maturity.
[(301) 921-3786]

Integrated Circuit Test Structures

Mazer, J.A. and Linholm, L.W., **Comments on "Determining Specific Contact Resistivity from Contact End Resistance Measurements"**, IEEE Electron Devices Letters, EDL-5, pp. 347-348 (September 1984).

Comments are rendered on the application of the transmission-line model (TLM) to the determination of specific contact resistance by Chern and Oldham in a recent letter appearing in this journal. Comments are also made on those authors' interpretation of related work by Proctor and Linholm. It is shown that Chern and Oldham have misinterpreted some of the results of Proctor and Linholm and have failed to recognize certain critical assumptions that underlie the TLM.
[(301) 921-3621]

Schafft, H.A., Younkins, C.D., Grant, T.C., Kao, C.-Y., and Saxena, A.N., **Effect of Passivation and Passivation Defects on Electromigration Failure in Aluminum Metallization**, 22nd Annual Proceedings, Reliability Physics 1984, Las Vegas, NV, pp. 250-255 (April 3-5, 1984).

Metal line structures with intentional defects in the passivation, to simulate cracks or pin holes, were used in electromigration studies. Results show that the stress changes in the metallization caused by these defects are not as important as the restraining action of the passivation in affecting a metallization's resistance to electromigration failure. Also, the observed effects of restorative forces acting on the metallization suggests that continuous monitoring for open-circuit failure may be necessary to obtain an accurate measure of the mean-time-to-failure.
[(301) 921-3621]

Packaging

Moore, B.A. and Ruthberg, S., **RADC/NBS Workshop - Moisture Measurement and Control for Semiconductor Devices, III**, NBSIR 84-2852 (May 1984).

The workshop, one of a series concerned with measurement problems in integrated circuit processing and assembly, served as a forum to examine the continuing progress that has been made in the measurement and control of moisture in hermetically packaged semiconductor devices. Thirty-four presentations are included which contain detailed information for securing hermetic packages with low moisture content. Agreement in measurement has been obtained with the mass spectrometer for cerdip and metal packages at the 5000 ppmv level of moisture through the use

Packaging, cont'd.

of suitable moisture generators, a 3-volume calibrator, calibrated dewpoint hygrometers, and appropriate operational procedures. An approach is given for a reproducible and reliable transfer package. However, the increased use of organic materials in new and rapidly expanding technologies such as VLSI/VHSIC and hybrid packaging presents new and more complex challenges to accurate measurement of interior moisture.
[Contact: Ruthberg (301) 921-3625]

Other Semiconductor Metrology

Forman, R.A. and Kratz, H.D., **A Simple Vacuum Pump Exhaust Filter**, Rev. Sci. Instrum., 55, p. 1503 (Sept. 1984).

A simple high throughput, exhaust filter for oil-filled mechanical vacuum pumps is described. The design allows easy connection to external systems. Inexpensive filter elements, available anywhere, are a further feature of the system. [(301) 921-3625]

Hinkley, J.A., **Adsorption of Polystyrene on Thermally Oxidized Silicon**, Polymer Preprints, 25, pp. 178-179 (April 1984).

Ellipsometry was used to observe the adsorption, from theta solvents, of polystyrene on thermally oxidized silicon. Since no adsorption was seen with a polar solvent, it is concluded that specific acid-base interactions are decisive in adsorption. At high surface coverages, the present results agree with those on various metal surfaces, and the root-mean-square extension of polymer coils from the surface is almost twice the radius of gyration of a chain in solution.
[Contact: G.P. Carver, (301) 921-3786]

FAST SIGNAL ACQUISITION, PROCESSING, AND TRANSMISSION

Noise Metrology

Miller, C.K.S. and Daywitt, W.C., **The NBS Switching Radiometers**, NBSIR 84-3004.

An error analysis for the Dicke radiometers used by the National Bureau of Standards (NBS) in their WR90 and WR62 waveguide noise calibration services for sources with noise temperatures above 1000 kelvin is discussed. A list of measurement frequencies currently available in the WR90 and WR62 bands is presented.
[(303) 497-3131]

Miller, C.K.S. and Daywitt, W.C., **The NBS WR62 and WR90 Reference Noise Standards**, NBSIR 84-3005.

The basis for the National Bureau of Standards (NBS) WR90 and WR62 Waveguide Reference Noise Standards and the corresponding error analyses are described. The standards are heated (1270 K) thermal noise generators, and a derivation of their output noise temperature equations is also presented. Results of comparisons of the NBS WR90 standard with those of Sweden, England, Australia, and Japan are included. The text is extracted from course notes presented at NBS in 1970, and hence does not include descriptions of standards constructed at NBS since that time.
[(303) 497-3131]

Microwave and Millimeter-Wave Metrology

Judish, R.M. and Jones, R.N., **A Generalized Method for the Calibration of Four-Terminal-Pair Type Digital Impedance Meters**, NBSIR 84-3016 (August 1984).

Since the introduction of automated, four-terminal, pair-type impedance meters, there has been a continuing interest in the development of calibration techniques which would satisfactorily verify the accuracy capabilities of these instruments. Various attempts have been made and all have helped to provide a certain degree of confidence in instrument performance,

Microwave and Millimeter-Wave, cont'd.

but until now, a generalized approach with a good mathematical and statistical background has been lacking. This paper describes a calibration procedure having such a background and illustrates its use. The calibration is accomplished through the use of impedance standards which relate instrument readings to the values of the standards through a known functional relationship. The calibration procedure described estimates the parameters associated with the functional relationship and requires the use of a computer. Calibration is accomplished at the reference plane of the impedance standards and any adapter required to connect the standards to the instrument is assumed to be an integral part of the impedance meter.
[(303) 497-3380]

Other Fast Signal Topics

Kamper, R.A. and Kline, K.E., **Metrology for Electromagnetic Technology: A Bibliography of NBS Publications**, NBSIR 84-3014 (July 1984).

This bibliography lists the publications of the personnel of the Electromagnetic Technology Division of NBS in the period from January 1970 through December 1983. A few earlier references that are directly related to the present work of the Division are included.
[(303) 497-3535]

ELECTRICAL SYSTEMS

Power Systems Metrology

Fulcomer, P.M., **Calibration Check of Bonneville Power Administration 60-Hz Electric Field Exposure Monitor and Measurement of Its Surface Field Enhancement for Various Uniform and Nonuniform Operating Configurations**, NBSIR 84-2885.

This report presents the results of tests requested by the Bonneville Power Administration (BPA) on a 60-Hz Electric Field Exposure Monitor (EFEM) developed by their Instrumentation and Standards Branch. The unit is designed to be worn on the body, such as in a shirt pocket or attached to the clothing. The calibration of two sample units is examined, information on surface field enhancement (which results from the EFEM sensors' elevated position relative to the surface of the body) is presented, the effect of material covering the sensor is specified, and the applicability of calibration and operational information obtained in uniform fields to nonuniform fields is investigated.
[(301) 921-3121]

Hebner, R.E., **Development of Power System Measurements -- Quarterly Report January 1, 1984 to March 31, 1984**, NBSIR 84-2898.

This report documents the progress on three technical investigations sponsored by the Department of Energy and performed by the Electrosystems Division, the National Bureau of Standards. The work described covers the period from January 1, 1984 to March 31, 1984. The report emphasizes the performance of ion counters like those used to measure the ions near dc transmission lines, the production rates of oxyfluorides in SF_6 corona discharges, and the measurement of space charge associated with a pressboard interface in transformer oil.
[(301) 921-3121]

Magnetic Materials and Measurements

Fickett, F.R., **The Effect of Mill Temper on the Mechanical and Magnetoresistive Properties of Oxygen-Free Copper in Liquid Helium**, Advances in Cryogenic Engineering--Materials, Vol. 30, pp. 453-460 (July 1984).

Depending on the source of the ore and its subsequent processing, oxygen-free copper can show wide variations in low

Magnetic Materials and Meas., cont'd.

temperature mechanical and electrical properties. Further mechanical and thermal processing by the wire producer and final user will also affect the behavior of the copper as a stabilizer. Here we present data showing the effect of these processes on coppers from a variety of sources.
[(303) 497-3785]

Superconductors

Ekin, J.W., **Strain Effects in Superconducting Compounds**, Advances in Cryogenic Engineering--Materials, Vol. 30, pp. 823-836 (July 1984).

An overview of the effect of strain on the critical current, critical field, and critical temperature of A15, B1, and C15 superconductors is presented. Reversible elastic strain effects in many A15 superconductors have been measured, analyzed and compared in terms of simple strain scaling parameters. In addition, a new critical parameter -- critical strain $_c$ -- is described and used to characterize the strain sensitivity of these materials. The elastic strain effect is shown to be strongly dependent on crystal structure; it is nonexistent in all superconductors with the B1 and C15 crystal structure tested thus far. Possible mechanisms for explaining the elastic strain effect are briefly described. [(303) 497-5448]

Ekin, J.W., Pittman, E.S., Goldfarb, R.B., Superszynski, M.J., and Waltman, D.J., **Training Studies of Epoxy-Impregnated Superconductor Windings - Part III: Epoxies, Conductor Insulations and Copper Ratio**, Advances in Cryogenic Engineering--Materials, Vol. 30, pp. 977-984 (July 1984).

A systematic study of the materials and construction factors that affect training in epoxy-impregnated superconductor windings are reported. Using relatively small test rings (18 cm diam), the training rate was measured for several epoxies currently used in magnet construction. These training data correlated well with the strain at fracture measured on these same epoxy materials at 4 K. Results are also reported on the dependence of the training rate on the fiberglass cloth configuration in the winding, the type of superconductor insulation, and the copper-to-superconductor ratio of the conductor. [(303) 497-5448]

Goodrich, L.F., Vecchia, D.F., Pittman, E.S., Ekin, J.W., and Clark, A.F., **Critical Current Measurements on an NbTi Superconducting Wire Standard Reference Material**, NBS Special Publication 260-91 (September 1984), and Advances in Cryogenic Engineering--Materials, Vol.30, pp. 953-960 (July 1984).

This report reviews the selection and certification by NBS of a Standard Reference Material (SRM) for the measurement of superconducting critical current. Procedures for preparing and measuring five candidate conductors are described. Evaluation criteria are discussed by which one of the five conductors is selected for the critical current SRM. The designated superconducting wire, SRM 1457, has been subdivided and wound onto 500 spools for distribution. Certified critical current measurements were made on a sample of these spools. Material variability, or inhomogeneity, along the whole wire is included in a statistical model based on the dependence of critical current on temperature and electric field. Critical currents for SRM 1457 are certified at magnetic fields of 2, 4, 6, and 8 T for temperatures from 3.90 to 4.24 K and electric field criteria from 0.05 to 0.2 V/cm. Statistical tolerance limits and estimated systematic errors are combined to give an overall uncertainty in the certified values. The total uncertainty is no greater than 2.57 percent of the reported critical current at any of the four magnetic fields. [(303) 497-3143]

Superconductors, cont'd.

Pasztor, G. and Ekin, J.W., **Development of Nb_3Sn Cabled Conductor by External Diffusion Process and the Effect of Strain on the Critical Current**, Advances in Cryogenic Engineering, Vol. 30, pp. 787-795 (July 1984).

This paper describes detailed processing and procedures for producing stranded Nb_3Sn conductors using the external diffusion technique develped by Brown, Boveri & Co., Inc. and is at present being pursued at the Swiss Institute for Nuclear Research for applications in a planned high-fields test facility (12 Tesla). The results of processing trials intended to optimize the critical current density and at the same time to minimize the formation of Kirkendall voids are described. The results are presented of measurements of critical current as a function of applied tensile strain for a previously developed main cable.
[Contact: Ekin (303) 497-5448]

Tinkham, M., Beasley, M.R., Larbalestier, D.C., Clark, A.F., and Finnemore, D.K., **Research Opportunities in Superconductivity**, Cryogenics, July 1984, pp. 378-388.

Opportunities for research in the field of superconductivity are identified in this report of a "Workshop on problems in superconductivity" held at Copper Mountain, Colorado, August 22-23, 1983. Key problems in superconductivity, high payoff areas of research, barriers to progress, and the need for new facilities are outlined in the three areas of basic physics, materials, and devices.
[Contact: Clark (303) 497-3253]

ELECTROMAGNETIC INTERFERENCE

Kanda, M., **An Electromagnetic Near-Field Sensor for Simultaneous Electric and Magnetic-Field Measurements**, IEEE Trans. on Electromagnetic Compatibility, Vol. EMC-26, No. 3, pp. 102-110 (August 1984).

This paper describes the theory of a single sensor to perform simultaneous electric and magnetic near-field measurements. The theory indicates that it is possible to measure the magnetic-loop and electric-dipole currents using a loop antenna terminated with identical loads at two diametrically opposite points. The theory also indicates that it is possible to choose an ideal load impedance for achieving equal electric and magnetic-field responses of the loop. Preliminary experiments have been performed using a plane-wave field to verify these results.
[(303) 497-5320]

Wyss, J.C., Anson, W.J., and Orr, R.D., **Building Penetration Project**, NBSIR 84-3009.

This report documents a computer program which calculates building attenuation of electromagnetic radiation over the frequency range 10 kHz - 10 GHz. Attenuation (in dB) is computed from building shape, dimensions, room layout, and the electrical properties of construction materials; no electromagnetic measurements are required. Details of the structure and use of the program are given.
[Contact: Anson (303) 497-3989]

1985 CEEE CALENDAR

April 29 - May 10 (Boulder, CO)

NBS Electromagnetic Interference (EMI) Metrology Seminar. [Contact: Charles K.S. Miller (303) 497-3131]

July 23-25 (Vail, CO)

Short Course on Optical Fiber Measurements. [Contact: Robert L. Gallawa (303) 497-3761]

September 9-10

VLSI Packaging Workshop. Contact: George G. Harman (301) 921-3621]

also planned for May - June period

Shortcourse on Near-Field Techniques for Antenna Measurements [Contacts: Ramon C. Baird (303) 497-3301; Richard L. Lewis (303) 497-5196]

Seminar on Electrical Measurements in Diagnostic X-Ray Units [Contact: Robert E. Hebner (301) 921-3121]

NEW STANDARD REFERENCE MATERIAL

The first practical superconducting standard reference material (SRM) has been released by the Electromagnetic Technology Division to the NBS Office of Standard Reference Materials for sale to the public. The certified parameter of SRM 1457, Superconducting Critical Current -- NbTi Wire, is critical current at magnetic fields of 2,4,6, and 8 tesla at a temperature of 4.2 K and an electric field criterion of 0.2 V/cm. Information is given to permit the user to determine critical current for temperatures in the range 3.90 to 4.24 K and electric field criteria from 0.05 to 0.2 V/cm.

SRM 1457 consists of a 2.2-m length of a multifilimentary, niobium-titanium, copper-stabilized wire, wound in a single layer on a spool having a core diameter of 8.7 cm. The wire is evaluated for 34 parameters relating to current, voltage, magnetic field, temperature, strain, and physical specimen characteristics.

In conjunction with ASTM Standard Test Method B714-82, D-C Critical Current of Composite Superconductors, the new SRM is intended to provide means for calibrating apparatus used to measure key parameters of superconductor products and thus should be useful to buyers and sellers of superconductors, users of superconducting equipment, and researchers in superconducting technology.

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10. SUPPLEMENTARY NOTES

All technical information included in this document has been approved for publication previously.

☐ 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)

This is the second issue of a quarterly abstract journal covering the work of 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 third quarter of calendar year 1984. Abstracts are provided by technical area for papers published this quarter.

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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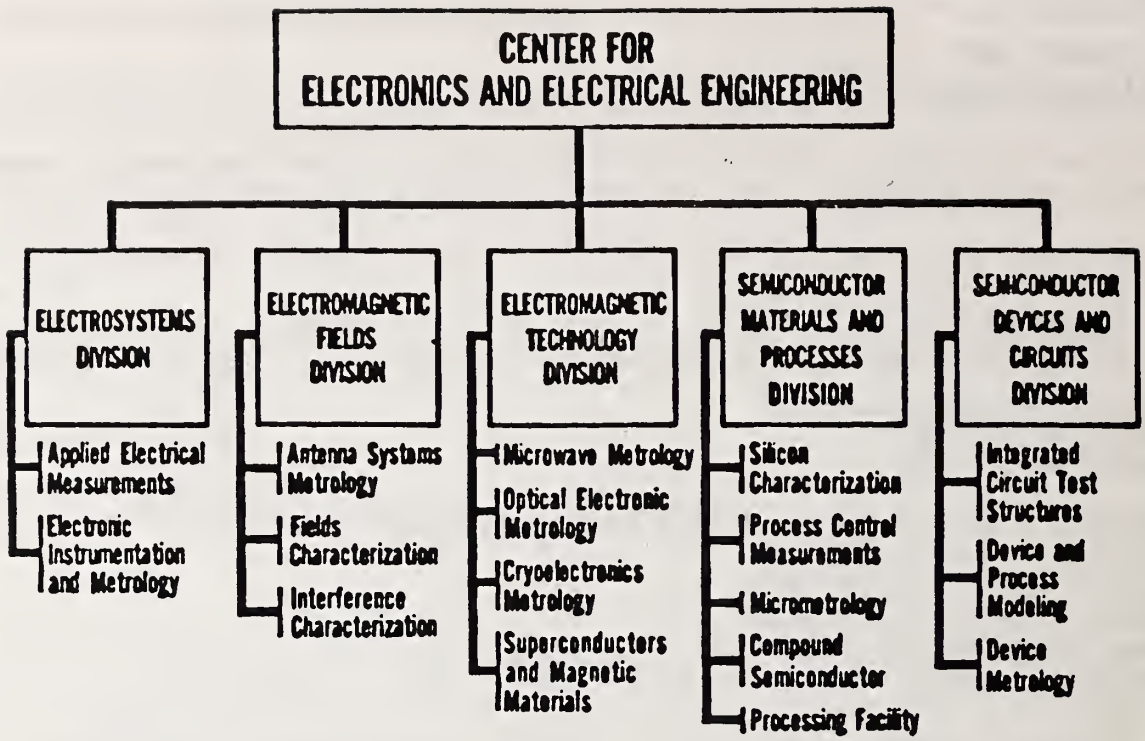

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