Technical Publication Announcements

Covering Center Programs, July to September 1986, with 1987 CEEE Events Calendar

July 1987

U.S. Department of Commerce
National Bureau of Standards
National Engineering Laboratory
Gaithersburg, Maryland 20899
This is the tenth issue of a quarterly publication providing information on the technical 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 1986.

Organization of Bulletin: 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 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 1987, some preliminary events for 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 Electro-systems 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 Bureau of Standards and a number of other organizations, in both the Federal and private sectors; these are identified on page 15.

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 11.
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SEMICONDUCTOR TECHNOLOGY

Analysis Techniques


Many calibration factors for infrared absorption measurements of oxygen in silicon have been reported in the literature and adopted as standard during the past three decades. Reasons for this variability are examined and a new international experiment to establish a universally acceptable value and the reliability to which it can be found are described.

[Contact: Aslan Baghdadi, (301) 975-2062]


A small rectangular pulse technique for measuring the charge pumping current has been proposed as a method to characterize interface traps near mid-gap. It is shown theoretically and experimentally that the small rectangular pulse technique can be used to predict the surface generation current measured on a metal oxide-semiconductor field-effect transistor or a gated diode. This new technique has the advantage that the measured current is at least 10 to 100 times larger than the surface generation current.

[Contact: Gary P. Carver, (301) 975-2091]

Dimensional Metrology


The basic premise underlying the use of the scanning electron microscope for linewidth measurement for semiconductor research and production applications is that the video image acquired, displayed, and ultimately measured reflects accurately the structure of interest. This paper demonstrates that depending upon the mode of electron detection (secondary, backscattered, or converted backscattered secondary electrons) and accelerating voltage used to image and measure the structure of interest, a variety of results can be obtained. The reasons for these differences are discussed relative to the coupling of this type of work with electron beam/sample interaction modeling to enable the acquisition of more precise linewidth measurements.

[Contact: Michael T. Postek, (301) 975-2299]

Integrated Circuit Test Structures


A major factor limiting the production and performance of high-density VLSI integrated circuits is the fabrication of reliable interconnect systems. Properly designed microelectronic test structures and appropriate test methods can be used to characterize the processes used to fabricate these systems. However, the computer-controlled testing of comprehensive process evaluation and
IC Test Structures (cont'd.)

of comprehensive process evaluation and diagnosis structures often results in large quantities of data which cannot be readily or effectively interpreted by the user. As a result, important features of the data are often overlooked or not considered in the evaluation of the fabrication processes. This paper describes an expert system for assisting the user to interpret test results associated with fabricating selected aspects of VLSI interconnect systems.

[Contact: Loren W. Linholm, (301) 975-2052]

Device Physics and Modeling


The Klauder self-energy method is applied to calculating the effects of one-body interactions among the dopant ions and the carriers in heavily doped silicon at 300 K. Many-body interactions of exchange energy for majority carriers and of correlation energy for minority carriers are estimated by interpretation of optical absorption measurements and by calculations based on degenerate theory. When densities exceed $5 \times 10^{19}$ cm$^{-3}$, one-body and many-body terms become of the same order of magnitude and should be included in calculations of band-structure changes and of properties such as carrier transport which depend on the density of states.

[Contact: Herbert S. Bennett, (301) 975-2079]


The accuracy and reliability of predictions from numerical simulations of advanced bipolar transistors depend on model input parameters. These parameters include the variations with doping and carrier concentrations in both n-type and p-type material of 1) the valence and conduction band edges, 2) the effective intrinsic carrier concentrations, 3) the minority carrier mobilities, and 4) the minority carrier lifetimes. This paper contains a summary of recent advances in device physics for modeling silicon bipolar transistors with submicrometer dimensions and high concentrations of dopant ions and carriers. It also contains preliminary results in device physics for modeling those regions of GaAs bipolar transistors which have high concentrations of either dopant ions or carriers. The latter results are based on lessons learned from modeling advanced silicon bipolar devices.

[Contact: Herbert S. Bennett, (301) 975-2079]


The MOS capacitor model in SEDAN has been modified to include the effects of an energy-dependent Si-SiO$_2$ interface trap density and arbitrary silicon substrate doping profiles. These modifications have been used to calculate the quasi-static C-V characteristics of MOS capacitors and to compare them with those measured by the Kuhn technique for as-received and for gamma-irradiated p-well and n-type silicon MOS capacitors. The average substrate doping is obtained from high-frequency C-V curves. For the n-type substrate, the dopant redistribution was estimated with SUPREM II. Experimental and theoretical C-V curves were made to agree by varying the voltage offset due to fixed oxide charge and both the magnitude and the energy
Device Physics & Modeling (cont'd.)

distribution of interface trapped charge. The distributions of interface traps which gave the best fits between experiment and theory have peaks near mid gap for the p-well and n-type silicon MOS capacitors.

[Contact: Herbert S. Bennett, (301) 975-2079]


The effects on the turn-off failure of power metal oxide-semiconductor field-effect transistors (MOSFETs) which result from forward biasing the intrinsic drain-source diode immediately prior to turn-off are discussed. A nondestructive test circuit is used to measure the turn-off characteristics of individual devices under a variety of conditions. It is shown that the drain voltage at which the device fails decreases as either the diode forward current or the reverse recovery current is increased. If the diode is forward biased, the voltage at failure can be less than one-half of the voltage at which the device fails if the diode has not been forward biased (and often less than one-half the manufacturer-rated voltage capability for the device). Also, if turn-off of the MOSFET is attempted with the diode conducting, the device loses its fast turn-off capability due to charge storage effects. A parallel resonant power converter circuit is employed to demonstrate how the intrinsic drain-source diode may and may not be used safely in practical applications.

[Contact: David W. Berning, (301) 975-2069]

Insulators and Interfaces


A Standard Reference Material (SRM) has been designed and fabricated, and will be calibrated for thickness and refractive index using a highly accurate ellipsometer. The SRM consists of a three-inch diameter silicon wafer with a silicon dioxide film of uniform thickness. The design and preparation of the SRM is discussed and the ellipsometric measurement results and their comparisons with stylus profilometry are presented, along with an analysis of the precision of the measurements. The ellipsometric accuracy depends upon the wafer oxide film, the model that represents the film-interface-substrate system, and the methods used to make the measurements. Use of both correct sample preparation and correct model is important in order to obtain high accuracy for comparisons of optical thickness as determined by the ellipsometer and mechanical thickness as determined by the stylus profilometer. This SRM will be available initially in three nominal oxide film thicknesses of 50, 100, and 200 nm. The SRM can be used to calibrate many different optical and mechanical thickness monitoring instruments as well as the ellipsometer for which it was specifically designed.

[Contact: George A. Candela, (301) 975-2086]


Van der Pauw-type measurements with a
Insulators & Interfaces (cont'd.)
specially designed test structure and spreading resistance measurements indi-
cate that the sheet resistance directly under a sintered 1% Si-Al/Si ohmic con-
tact is lower than the sheet resistance of the diffused layer away from the
contact. These results agree with transmission-line calculations made with
measurements from six-terminal Kelvin test structures, and allow an improved
calculation of the circuit-loading (or front-contact) resistance.
[Contact: James R. Ehrstein, (301) 975-2060]

Mountain, D.J., Russell, T.J., and Gal-
loway, K.F., Effect of Post-Oxidation
Anneal on Electrical Characterization
of Thin Oxides, Extended Abstracts of
the Electrochemical Society 169th
Meeting, Boston, Massachusetts, May
4-9, 1986, pp. 382-383.

The effect of pre- and post-oxidation
treatments on thin oxide electrical
characteristics was examined. Pre-oxi-
dation clean and post-oxidation anneal
(POA) times and ambients were varied.
Three POA times and two gases (argon and
nitrogen) were compared. Flatband volt-
ages, oxide breakdown fields, and inter-
facing trap densities were measured for
thin (20-nm) oxides. Interface trap densi-
ties were measured using the charge-pumping technique. Data indicate
an optimum process can be designed. A
sacrificial oxidation cleaning sequence
and a long (120-min) POA in nitrogen
gave the oxide with the best electrical
characteristics.
[Contact: Thomas J. Russell, (301) 975-
2073]

Other Semiconductor Topics

Dodge, M., Refractive Index, CRC
handbook of Laser Science and Technol-
ogy, Vol. IV, Optical Materials: Part
2, M. J. Weber, Ed. (CRC Press, Boca

This section defines refractive index,
gives the general form of the Cauchy,
Sellmeier, and Hertzberger dispersion
equations, and discusses the environmen-
tal factors that must be considered in
the determination and use of refractive
index values for a particular material.
Tables are included that give the re-
fractive index and the temperature co-
efficient of refractive index for crystals
that are of particular interest for the
fabrication of optical components to be
used in laser systems.

Dispersion equations and equation param-
eters are also given for some of the
materials.
[Contact: Marilyn Dodge, (301) 975-2386]

Ma, Y., Stern, E.A., and Bouldin, C.E.,
The Structural Unit in Icosahedral
MnAlSi and MnAl, Physics Review
Letters, Vol. 57, No. 13, pp. 1611-1614
(Sept. 29, 1986).

Extended x-ray-absorption fine-structure
measurements were made on icosahedral
MnAl and MnSiAl, and on the periodic
standards α-phase of MnSiAl and ortho-
rhombic phase of MnAl_6. Experimental
evidence is presented that a cage of Mn
atoms at the vertices of an icosahedron
is the structural unit in the icosahedral
MnSiAl and MnAl phases. The connec-
tions among these icosahedral units and
between them and the Al atoms are dif-
ferent in the icosahedral phases and in the α-phase. As in the α-phase, the Mn
icosahedra do not share vertices in the
icosahedral phases; i.e., they are
separated from one another. It is sug-
gested that the i-phase grows by random-
ly nucleating together Mn icosahedra
along their 20 threefold directions, as
allowed by local steric constraints.
[Contact: Charles E. Bouldin, (301) 975-2046]

FAST SIGNAL ACQUISITION, PROCESSING, &
TRANSMISSION

Cryoelectronic Metrology

Hamilton, C.A., Kautz, R.L., and Lloyd,
Cryoelectronic Metrology (cont'd.)


It has been realized for many years that the accuracy of Josephson voltage standards can be substantially improved by using many junctions in series to generate a large voltage. A simple series extension of the single junction standard requires individual control of the bias current, for example, for each junction of 100 mV using 20 junctions. In 1977 Levinsen et al. suggested a method to avoid the multiple bias problem by using constant-voltage steps which cross the zero-current axis of the plot of junction current as a function of voltage (I-V curve). This allows a large array of junctions to share a common current bias at or near zero. With an array of 1000 or more junctions, a quantized voltage of 1 V is possible. After nearly ten years of effort, the problems of fabrication, stability, and radio-frequency energy distribution are largely solved and Josephson standards at the 1-V level are a reality. This paper reviews the design and operation of series array voltage standards and describes the efforts at NBS to engineer a versatile, reliable, and easily used voltage standard system.
[Contact: Clark A. Hamilton, (303) 497-3740]

Noise Metrology

Daywitt, W.C., 10-60 GHz G/T, Measurements Using the Sun as a Source -- A Preliminary Study, NBSIR 86-3046 (April 1986).

Preliminary studies show that it may be possible 1) to determine the solar flux density incident on the earth's atmosphere using a simple algorithm with an uncertainty less than 8 percent, 2) to overcome a deteriorating accuracy in atmospheric loss calculations by using a "tipping curve" measurement, and 3) to reduce starshape correction factor uncertainty by using an equivalent solar diameter.
[Contact: William C. Daywitt, (303) 497-3720]

Optical Fiber Metrology


The bend-induced linear birefringence in coils of single-mode optical fiber has been greatly reduced by annealing. This should allow the construction of electric current sensors that are much more compact and potentially more sensitive than previously possible.
[Contact: Gordon W. Day, (303) 497-5204]


This paper presents the results of an experiment to compare three distinct methods of measuring the bandwidth of a telecommunication-grade, multimode optical fiber. The three methods are: 1) the time-domain method, 2) the frequency-domain method, and 3) the pulse spectrum analysis method. We find good agreement between the frequency-domain method and the pulse spectrum analysis method, but the time-domain method yields results that are lower than the other two for the cases we considered.
[Contact: Robert L. Gallawa, (303) 497-3761]

Electro-Optic Metrology

Young, M., Low-Cost LCD Video Display for Optical Processing, Applied Op-
Electro-Optic Metrology (cont'd.)

... their suitability for use in a low-temperature micropositioner. Experimental data are presented on bimorph sensitivity (displacement per volt) as a function of the number of temperature cycles. Results indicate that bimorphs of this type cannot be calibrated because of irreversible changes in the bending characteristics that occur while cycling from room temperature to 4 K.

[Contact: John Moreland, (303) 497-3641]


The scratch standard (MIL-0-13830A) is a cosmetic standard that is effected by a visual comparison with a set of secondary standards that are in turn evaluated by comparison with a set of master standards. Both manufacture and certification of the secondary standards are somewhat unreliable. This paper shows that they can be classified according to the relative power scattered at a relatively small angle and describes experiments with etched gratings that have the appearance of scratches but diffract light into a broad peak between 5 and 10 degrees off the axis of the incident beam. Some prototypes have been classified both by comparison with the master standards and by a photoelectric measurement; agreement between the two methods is good. Such gratings, used as the secondary standards, should display less intersample variation than scribed or other artifacts. The paper concludes by presenting evidence that the original primary standards have been stable over a long time.

[Contact: Matt Young, (303) 497-3223, -5342]

Other Fast Signal Topics


A multiply discriminating, three-loop superconducting monopole detector was operated for one year. During this period, 8523 hours of data were accumulated. The sensing area averaged over solid angle for trajectories passing through a loop was 178 cm². Including double coincidence events from trajectories passing through the shield but not through a loop, the total sensing area averaged over solid angle was 1195 cm². No candidate monopole events were observed, leading to an upper limit on the flux of cosmic ray magnetic monopoles of 5.0 x 10⁻¹² cm⁻² sr⁻¹ s⁻¹ with a 90% confidence level.

[Contact: Michael W. Cromar, (303) 497-5375]


Piezoelectric bimorphs constructed from lead titanate-zirconate (PZT) ceramic bonded to a brass sheet have been tested at cryogenic temperatures to determine
Power Systems Metrology (cont'd.)


This is a discussion of a technical paper presented at the winter meeting of the Power Engineering Society, IEEE. It questions some of the author's assumptions and references further applications of the measurement method described.
[Contact: Ronald H. McKnight, (301) 975-2431]

Pulse Power Metrology


Deconvolution methods have been applied to measurements made with different electrical sensors including resistive and capacitive dividers. Deconvolved and directly measured waveforms have been compared with good results.
[Contact: Ronald H. McKnight, (301) 975-3431]

Superconductors


A quench detector is a device that interrupts the flow of current through a superconductor in the event the superconductor reverts to the normal, resistive state. This new design has adjustable filtering and sensitivity. The input is well isolated from the output, eliminating any possible ground loop through the detector. It also has excellent noise immunity.
[Contact: Loren F. Goodrich, (303) 497-3143]


The National Bureau of Standards is engaged in a number of research programs which have as their goals the evaluation of various properties of practical superconductors related to their application in large-magnetic systems. The ability to have standard data, standard tests, and standard materials for evaluating the primary properties of superconductors and related measurement systems is essential if international commerce in these complicated conductors is to develop and grow. The NBS work has concentrated on measurement of critical current, critical field, ac losses, and properties of the copper normally used as a stabilizing material. Many parameters must be considered in these investigations. An overview of these research efforts and a selection of recent results are presented. Particular emphasis is given to work performed in cooperation with the International Copper Research Association (INCRA) on properties of oxygen-free copper.
[Contact: Frederick R. Fickett, (303) 497-3785]


Squeezable electron tunneling (SET) junctions consisting of superconducting NbTi filaments (extracted from magnet wires) and sputtered Nb thin-film counter electrodes were used to determine
Superconductors (cont’d.)

the energy gap at the surface of the filaments. The current versus voltage
curves of junctions immersed in liquid
helium at 4 K were measured for a series
of filaments taken from the same wire.
Each filament had been etched to remove
a surface layer of varying thickness so
that the energy gap could be determined
as a function of depth into the surface
of an average filament. It was found
that some manufacturing processes yield
filaments having surface layers with
reduced energy gaps of 0.4 meV compared
to measured interior bulk values ranging
from 1.2 to 1.3 meV.
[Contact: John Moreland, (303)
497-3641]

Magnetic Materials and Measurements

Capobianco, T.E., Fickett, F.R., and
Moulder, J.C., Mapping of Eddy Cur-
rent Probe Fields, Review of Progress
in Quantitative Nondestructive Evalua-
tion, Vol. 5A, Chap. 3, Sec. A (Plenum
705-711.

The magnetic fields produced by four
different eddy current probes were
mapped in the near field with very small
(0.43-mm) diameter inductive magnetic
field sensors. The four eddy current
probes included two nominally identical,
absolute, air-core probes; an absolute
terre-core probe; a reflection probe
with an air-core excitation coil; and
two counterwound ferrite-core pickup
coils. Measured fields for the air-core
probes are compared with values cal-
culated from the theory of Dodd and Deeds.
All measurements were performed at 10
kHz; for the ferrite core probe, the
field intensity was also measured from 1
kHz to 100 kHz using conventional
methods.
[Contact: Thomas E. Capobianco, (303)
497-3141]

Heinrich, B., Cochran, J.F., Myrtle, K.,
Lonzarich, G., and Goldfarb, R.B.,
23.9 GHz in the Weak Ferromagnet
Ni3Al, Journal of Magnetism and
1011-1012 (1986).

Ferromagnetic resonance (FMR) at micro-
wave frequencies of 9.55 and 23.895 GHz
has been measured in the archetypal weak
itinerant ferromagnet Ni3Al in the tem-
perature range from 4 to 60 K. The
observed FMR lines exhibited a strong
Dysonian asymmetry and were well de-
scribed over the whole temperature range
by Maxwell's equations that included
eddy currents, and by the Landau-
Lifshitz (L-L) equation of motion in-
cluding either Gilbert or L-L damping
terms. At 4 K, the best fits were ob-
tained using slightly angular dependent
relaxation rates of 2.4 x 108 s⁻¹ for
saturation magnetization, Mt, along
[111] and 2.0 x 108 s⁻¹ for Ms along
[100], and using a spectroscopic split-
ting factor g(Gilbert) = 2.2 ± 0.01 or
g(L-L) = 2.14 ± 0.01.
[Contact: Ronald B. Goldfarb, (303)
497-3650]

ELECTROMAGNETIC INTERFERENCE

Radiated Electromagnetic Interference

Crawford, M.L., and Koepke, G.H., De-
sign, Evaluation, and Use of a Rever-
beration Chamber for Performing Elec-
 tromagnetic Susceptibility/Vulnerabil-
ity Measurements, NBS Technical Note
1092 (April 1986).

This report presents the results of work
at the National Bureau of Standards to
evaluate, document, develop (when neces-
sary) and describe the methodology for
performing radiated susceptibility/vul-
erability measurements using a rever-
beration chamber. The report describes
the reverberation chamber theory of
operation, construction, evaluation,
functional operation, and use for per-
forming immunity measurements. It
includes an estimate of measurement uncer-
tainties derived empirically from test
results and from comparisons with ane-
choic chamber measurements. Finally, it
Radiated EMI (cont'd.)

discusses the limitations and advantages of the measurement technique to assist potential users in determining the applicability of this technique to their electromagnetic compatibility measurement needs.

[Contact: Myron L. Crawford, (303) 497-5497]


This report describes measurement procedures and results obtained from evaluating the reverberation chamber facilities located at the Naval Surface Weapons Center, Dahlgren, Virginia. Two chambers were tested referred to as 1) the half chamber, and 2) the full chamber. The facilities were developed by the NSWC for use in measuring and analyzing the electromagnetic susceptibility/vulnerability of weapon systems and the shielding effectiveness of enclosures and shielding materials. A brief description of each facility is given, including the instrumentation used for performing the evaluation and calibration of the facilities by the National Bureau of Standards. Measurements described include: 1) evaluation of the voltage standing wave ratios of the chamber's transmitting and receiving antennas; 2) measurement of the chamber's insertion loss or coupling efficiency versus frequency; 3) measurement of the effectiveness of the chamber tuners; 4) determination of the electric-field uniformity in the chamber's test zones versus frequency; 5) determination of the absolute amplitude calibration of the test electric fields in the chambers, based upon received power measurements of the reference antenna and calibrated dipole probe antenna measurements; and 6) comparison of the response of reference equipment under test to test fields established inside the NSWC reverberation chambers and the NBS reverberation chamber. These results can then be compared to anechoic chamber results. Conclusions given indicate that the NSWC chambers can be used at frequencies down to approximately 150 MHz. Estimates are given of the measurement uncertainties derived empirically from the test results.

[Contact: Myron L. Crawford, (303) 497-5497]


This paper discusses the design, evaluation, and use of a reverberation chamber for performing electromagnetic susceptibility (EMS) measurements of electronic equipment. Included are brief descriptions of the test procedures, application advantages and limitations, some EMS test results, interpretation of test results relative to free-space test methods, and an estimate of measurement uncertainties.

[Contact: Myron L. Crawford, (303) 497-5497]

Friday, D.S., Methodology for Statistical Control of the Anechoic Chamber Field Generation System, NBSIR 85-3033 (January 1986).

The microwave anechoic chamber in question is an NBS laboratory facility in which standard plane-wave electromagnetic fields are generated. This chamber enables specialized measurements and electromagnetic interference/electromagnetic compatibility tests to be conducted on antennas and other devices. This paper is concerned with methodology for assuring that the standard field patterns generated in the NBS and similar chambers are repeatable. Procedures are proposed for developing a database from measurements obtained by placing the system, which generates the fields, in certain relevant reference configura-
Radiated EMI (cont'd.)


Simple, approximate expressions for determining the cutoff frequencies of the first few higher-order modes and the associated resonances in transverse electromagnetic (TEM) cells are presented. Both symmetric and asymmetric cells are discussed with examples.
[Contact: Perry F. Wilson, (303) 497-3842]


Shielding effectiveness relates to a material's ability to reduce the transmission of propagating fields in order electromagnetically to isolate one region from another. Because a complex material's shielding capability is difficult to predict, it often must be measured. A number of measurement approaches are studied including the use of a shielded room, coaxial transmission line holders, time-domain signals, the dual transverse electromagnetic (TEM) cell, and an apertured TEM cell in a reverberation chamber. In each case, we consider the system's frequency range, test sample requirements, test field types, dynamic range, time required, analytical background, and present data taken on a common set of materials.
[Contact: Perry F. Wilson, (303) 497-3842]

ADDITIONAL INFORMATION

Lists of Publications


This bibliography lists publications of
Lists of Publications (cont'd.)

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]


This bibliography lists the publications of the personnel of the Electromagnetic Technology Division of NBS in the period from January 1970 through December 1985. A few earlier references that are directly related to the present work of the Division are included.
[Contact: Kathryn E. Kline, (303) 497-3678]


This bibliography covers publications of the Electro systems Division, Center for Electronics and Electrical Engineering, NBS, and of its predecessor sections for the period January 1963 to January 1987. A brief description of the Division's technical program is given in the introduction.
[Contact: Jenny C. Palla, (301) 975-2220]


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 1986. An index by topic area and a list of authors are provided.
[Contact: E. Jane Walters, (301) 975-2050]

1987 CEEF Calendar

July 28-30 (Vail, CO)

Short Course on Optical Fiber Measurements. This course is sponsored by the National Bureau of Standards and the University of Colorado with the cooperation of members of industry who serve as faculty together with staff from the Electromagnetic Technology and Electromagnetic Fields Divisions. The course is intended for scientists and engineers involved in optical fiber characterization and emphasizes concepts, techniques, and apparatus used in measuring engineering parameters of telecommunications-grade fibers.

The following major topic areas are addressed: optics for communications, emphasizing geometric optics concepts; fiber properties and parameters; index-profile measurements; fiber bandwidth measurements in the frequency and time domains; fiber attenuation measurements; connector and splice losses; optical time-domain reflectometry concepts and applications; single-mode fibers; statistics and error analyses, measurement uncertainties; and fibers for sensors.
[Contact: Office of Conference Services, University of Colorado (303) 492-8630; Robert L. Gallawa (303) 497-3761; or Matt Young (303) 497-3223]

September 14-16 (Research Triangle Park, NC)

VLSI and GaAs Packaging Workshop. This Workshop is co-sponsored by the Components, Hybrids, and Manufacturing Technology Society of IEEE and NBS; attendees are expected to be knowledgeable in the field and to participate in discussions. Topic areas include: VLSI and wafer scale package design (characterization and implementation, cost and performance driven solutions); package thermal design (characteristics, re-
results, and issues); package interconnection options (wire bonding, TAB, flip chip, or optical); GaAs IC packaging (high speed packaging considerations); package electrical issues (reduction of parasitics and improvements in electrical performances); integrating package design (from die to system, including assembly and test issues); VLSI package materials advancements; die-attach solutions for large chips; new failure mechanisms in VLSI packaging. [Contact: George G. Harman, (301) 975-2097]

September 16-18 (Gaithersburg, MD)

Workshop on the Role of Optical Sensors in Power Systems' Voltage and Current Measurements. This Workshop is sponsored by NBS, the Bonneville Power Administration (BPA), the Electric Power Research Institute (EPRI), and the Empire State Electric Energy Research Corporation (ESEERC) and is intended for research and development engineers in utilities and in companies that supply equipment to the utility industry. The objective of this workshop is to identify anticipated opportunities for improved measurement techniques that should arise as power systems individually and collectively evolve to meet the needs of the 1990s. Presentations will stress the design and testing of optical systems for 60-Hz voltage or current measurement; the interfacing of electronic or optical components with existing metering and control systems; opportunities for new measurement hardware resulting from increased automated control of power systems and of the testing of power system components; and optical techniques for the measurement of electric and magnetic fields in power systems or system components. The results of an NBS study evaluating optical techniques for power-system electrical measurements and carried out in agreement with BPA, EPRI, and ESEERC will be presented as an invited keynote. [Contact: Raymond S. Turgel, (301) 975-2420 or Robert E. Hebner, (301) 975-2403]

September 22-25 (Boulder, CO)

Noise Measurement Seminar. This four-day course is presented and hosted by the Electromagnetic Fields Division in cooperation with representatives from industry and the NBS Time and Frequency Division. It is intended for practicing noise metrologists and technical managers responsible for systems in which accurate measurements of thermal and phase noise are important. Attendees will learn the most important precautions to take in making accurate noise measurements and will receive a set of notes that are suitable for use in solving precision noise measurement problems. Course topics include reference thermal noise sources; thermal noise measuring systems and techniques; phase noise; and the problems of measuring thermal noise in passive components, amplifiers, and communication systems.

The course design combines formal lectures on theory presented by NBS staff and industry experts with demonstrations in NBS laboratories and demonstrations of commercial equipment. A special feature of the Seminar is the opportunity each day for attendees to share their experiences in solving specific problems or their insights on practical noise measurement issues through short presentations to the assembled group. Time is scheduled for group discussions of these presentations and other topics raised by the Seminar. [Contact: Sanchana Perera (303) 497-3546]

October 26-28 (Boulder, CO)

Symposium on Optical Materials for High Power Lasers (Nineteenth Boulder Damage Symposium). This Symposium is cosponsored by the National Bureau of Standards, the American Society for Testing and Materials, the Air Force Office of Scientific Research, the Office of Naval Research, and the Defense Advanced Research Projects Agency and constitutes a principal forum for the exchange of information on the physics and technology of materials for high-
Topics to be discussed include new materials, bulk damage phenomena, surface and thin-film damage, design considerations for high-power systems, and fundamental mechanisms of laser-induced damage. Proceedings of the Symposium will be published (Note: The collection of Symposium proceedings contains information on optics for all aspects of high-power/high-energy lasers, including environmental degradation, durability, fabrication, material growth and deposition processes, and testing). [Contact: Susie A. Rivera (303) 497-5342]

December 10-11 (Gaithersburg, MD)

Power Semiconductor Devices Workshop. This Workshop, sponsored jointly by IEEE and NBS, is intended to bring together for interactive participation those actively working in the field of power semiconductor devices. It will be held in conjunction with the 1987 IEEE International Electron Devices Meeting in Washington, DC. Four specific topic areas have been selected, based on the response to a questionnaire sent to over 200 power device researchers worldwide. They are: power and high voltage integrated circuits, discrete devices, device modeling, and packaging. Attendees are expected to be prepared to contribute to the development of responses to specific questions that arise in the context of the particular topic areas; a final schedule identifying the topic areas should be available at the end of October. [Contact: David L. Blackburn, (301) 975-2053]

1988 CEEE Calendar

February 10-12 (San Diego, CA)

IEEE Semiconductor Thermal and Temperature Measurement Symposium. This fourth annual SEMI-THERM symposium is sponsored by the Components, Hybrids, and Manufacturing Technology Society of IEEE in cooperation with NBS and constitutes an international forum for the presentation of new developments in, and applications relating to, generation and removal of heat within semiconductor devices and measurement of junction temperatures experienced in various applications and environments. Major SEMI-THERM topic areas include thermal measurements, thermal characterization, applications, and computation and software.

The program includes keynote speakers, technical presentations, tutorial sessions, workshops, and an exhibit. In addition, the Semiconductor Equipment and Materials Institute has scheduled in conjunction with SEMI-THERM a meeting of its Thermal Measurements Task Force, to which attendees are invited. [Contact: Frank F. Oettinger, (301) 975-2054]

May 11-13 (Los Angeles, CA)

Intersociety Conference on Thermal Phenomena in Fabrication and Operation of Electronic Components. This Conference is sponsored by the Components, Hybrids, and Manufacturing Technology Society of the IEEE, in cooperation with ASME Committee K-16 on Heat Transfer and NBS. It is intended to provide an interdisciplinary forum for exploring the progress made in understanding, analyzing, and modeling thermal transport processes and thermally induced failures in the fabrication, assembly, and use of logic, memory, and data-storage systems. Major topic areas covered are 1) processing and fabrication, including state-of-the-art semiconductor crystal growing techniques; thermal stress in wafers, chips, substrates, PC boards, and joints; and encapsulant behavior with respect to solidification, outgassing, mechanical properties, and water vapor diffusion and absorption; 2) packaging technology, including means for cooling components from cryogenic to high temperatures and reliability as affected by failure mechanisms such as dopant migration and intermetallic growth; and 3) peripheral
1988 CEEE Calendar (cont'd.)
equipment, including data storage in both magnetic and optical media and thermal issues in dot-matrix and thermal printer heads. The conference is being held in conjunction with the Electronics Components Conference (May 9-11) at the same site. [Contact: Frank F. Oetinger, (301) 975-2054]

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**Abstract**

This is the tenth issue of a quarterly publication providing information on the technical 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 1986. Abstracts are provided by technical area for papers published this quarter.

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