



reliability
physics
1979

San Francisco, California, April 24–26, 1979

Sponsored by the IEEE Electron Devices Society and the IEEE Reliability Society

> IEEE Catalog No. 79CH1425-8PHY Library of Congress Catalog Card No. 79-87999

Copyright © 1979 by the Institute of Electrical and Electronics Engineers, Inc. 345 East 47th St., New York, N.Y. 10017

1979 INTERNATIONAL RELIABILITY PHYSICS SYMPOSIUM

SYMPOSIUM OFFICERS

GENERAL CHAIRMAN	F. B. Micheletti, Rockwell International
VICE GENERAL CHAIRMAN	G. T. Cheney, Bell Laboratories
SECRETARY	C. E. Ehrenfried, IITRI (RAC)
FINANCE	. C. R. Murphy, Rockwell International

SYMPOSIUM COMMITTEE CHAIRMEN

TECHNICAL PROGRAM	J. R. Edwards, AMI
PUBLICITY	P. E. Kennedy, Hughes Aircraft
REGISTRATION	C. S. Symeon, Harris Semiconductor
ARRANGEMENTS	G. H. Ebel, Singer
PUBLICATIONS	R. C. Walker, IITRI (RAC)

BOARD OF DIRECTORS

- J. H. Martin, Chairman

 Draper Laboratory
- H. E. Nigh, Electron Device Society

 *Bell Laboratories**
- D. F. Barber, Reliability Society

 USAF (RADC)
- O. D. Trapp, Electron Device Society Technology Associates
- H. C. Jones, Reliability Society
 Westinghouse Electric
- F. B. Micheletti, '79 General Chairman Rockwell International

Published By The ELECTRON DEVICES SOCIETY AND RELIABILITY SOCIETY of the INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS, INC.

Abstracting is permitted with credit to the source. Libraries are permitted to photocopy beyond the limits of U.S. copyright law for private use of patrons those articles in this volume that carry a code at the bottom of the first page, provided the per-copy fee indicated in the code is paid through the Copyright Clearance Center, P.O. Box 765, Schenectady, NY 12301. Instructors are permitted to photocopy isolated articles for noncommercial classroom use without fee. For other copying, reprint or republication permission, write to Director, Publishing Services, IEEE, 345 E. 47 St., New York, NY 10017. All rights reserved. Copyright © 1979 by The Institute of Electrical and Electronics Engineers, Inc.

INTERNATIONAL RELIABILITY PHYSICS SYMPOSIUM AWARD

The International Reliability Physics Symposium Award for Outstanding Contributions in the Field of Reliability Physics was first authorized in 1971 by the Symposium Board of Directors. This award, which is not necessarily given annually, is presented to individuals who have made major significant contributions to the advancement of the field of reliability

The 1979 award was presented to D. Stewart Peck of the Bell Telephone Laboratories, Allentown, Pennsylvania, in recognition of his numerous contributions to the field of Reliability Physics. He was an early proponent of log-normal life distributions for semiconductor devices and a missionary for accelerated testing. These techniques are used by companies throughout the world and have become very important tools for quality control, for rapid evaluation of process changes, and for predicting the useful life of new products. His papers and tutorials given at the symposium have been models of technical excellence and clarity. His work on temperature-humidity acceleration of metal electrolysis failure in semiconductor devices is particularly notable. Mr. Peck has also given years of dedicated service to the symposium as a member of the Management Committee, as a member of the Board of Directors and as General Chairman of the symposium.



INTERNATIONAL RELIABILITY PHYSICS AWARD PRESENTATION
D. Steward Peck, award recipient (left)
Jacob H. Martin, Chairman, Board of Directors (right)

TABLE OF CONTENTS

LSI FAILURE MODES

Session Chairman: Murray H. Woods

Method of Determining Reliability Screens for Time Dependent Dielectric Breakdown	
D. Crook	1
Low Field Time Dependent Dielectric Integrity E. S. Anolick and G. R. Nelson	8
Measurement of Alpha Particle Radioactivity in I.C. Device Packages E. S. Mejeran, P. Engle and T. May	13
Component/System Correlation of Alpha Induced Dynamic RAM Soft Failure Rates	
C. Huang, A. J. Lewandowski, M. J. Nelson and E. R. Orr	23
Analysis of Dynamic RAMs by use of Alpha Irradiation G. Schindlbeck	30
Certain Failure Mechanisms in Two-Level Poly-Si Gate Structures — A Transmission Electron Microscope Study A. K. Sinha, T. T. Sheng, T. A. Shankoff, W. S. Lindenberger,	
E. N. Fuls and C. C. Chang	35
PACKAGING AND ASSEMBLY Session Chairman: Owen D. Layden	
The Characteristic Wearout Process in Epoxy Glass Printed Circuits For High Density Electronic Packaging J. N. Lahti, R. H. DeLaney and J. N. Hines	39
A Metallographic Test for Glass-to-Metal Seal Quality J. McCormick and L. Zakraysek	44
Conductive Anodic Filaments in Reinforced Polymeric Dielectrics: Formation and Prevention	
D. J. Lando, J. P. Mitchell and T. L. Welsher	51
METALLIZATION AND PHOTOVOLTAIC RELIABILITY Session Chairman: John W. Peeples	
Electromigration of Sputtered Al-Si Alloy Films E. Nagasawa, H. Okabayashi, T. Nazaki and K. Nikawa	64
Electromigration Depletions in Pb-Sn Films G. DiGiacomo	72
Accelerated Stress Testing of Terrestrial Solar Cells J. L. Prince, J. W. Lathrop, F. W. Morgan, E. Royal and J. W. Witter	77

87
91
97
103
113
440
118
127
133
133
100
136
143
150
156
1/1
161
167

ANALYTICAL TECHNIQUES Session Chairman: Carl Green

Failure Analysis Techniques and Failure Mechanisms Utilizing a Plasma Etcher D. J. DeLorenzo, J. J. Gajda and J. A. Wade	171
Diagnosis of Hybrid Microelectronics Using Transmission Acoustic Microscopy C. S. Tsai, C. C. Lee and J. K. Wang	
Scanning Infrared Microscopy Techniques for Semiconductor Thermal Analysis C. A. Lidback	
The Use of Microfluorescence Analysis for Process Control in the Semiconductor Manufacturing Industry H. A. Froot	190
Analysis of Headspace Vapor in Sealed Electronic Packages Using Plasma Chromotography Mass Spectroscopy T. W. Carr	193
The Chemistry of Failure Analysis M. Jacques	
An Application of X-Ray Energy Dispersive Analysis to Semi-Conductor Plastic Packages G. Riga and P. Tang	209
LSI DEVICE TECHNOLOGY AND RELIABILITY Session Chairman: Dinesh Mehta	
PMOS Dynamic RAM Reliability — A Case Study C. W. Green	213
Reliability of LSI Memory Circuits Exposed to Laser Cutting M. J. Rand	220
Instability and Failure Mechanisms of Small Area, Nitride-Defined Schottky Barrier Diodes in LSI Applications S. U. Kim	226
Ion Implanted P-Resistor Reliability P. K. Chaudhari, G. R. Nelson and A. Nagarajan	
Analysis of Accelerated Temperature Cycle Test Data Containing Different Failure Modes G. A. Dodson	238