



**14th annual
proceedings**

**reliability
physics
1976**

Las Vegas, Nevada, April 20-22, 1976

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

IEEE Catalog No **76CH01072-8 PHY**

Library of Congress Catalog Card No. 76-180194

Copyright © 1976 by the Institute of Electrical and Electronics Engineers, Inc.
345 East 47th St., New York, N. Y. 10017

MANAGEMENT COMMITTEE

GENERAL CHAIRMAN	H. A. Lauffenburger
VICE GENERAL CHAIRMAN	A. L. Tamburrino
SECRETARY	P. H. Eisenberg
FINANCE	E. A. Herr
TECHNICAL PROGRAM	J. H. Martin
PUBLICITY	C. H. Zierdt
REGISTRATION	J. Gaffney
ARRANGEMENTS	F. B. Micheletti
PUBLICATIONS	J. S. Smith

BOARD OF DIRECTORS

D. S. Peck, G-R, IEEE Bell Laboratories	D. F. Barber, G-ED, IEEE USAF (RADC)
G. H. Parker, G-ED, IEEE Intel Corp.	K. H. Zaininger, G-ED, IEEE RCA Laboratories

EX OFFICIO

H. A. Lauffenburger, General Chairman IITRI	H. E. Nigh, Past General Chairperson Bell Laboratories
---	---

Published by the

**ELECTRON DEVICES AND RELIABILITY GROUPS
of the**

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS, INC.

Responsibility for the contents rests upon the authors and not upon the IEEE, the Groups, or its members. Individual copies may be purchased at the Publications Sales Department, the IEEE, 345 East 47th Street, New York, New York 10017 for \$16 per copy; a 25% discount will be allowed IEEE members. Request catalogue 76CH01072-8 PHY.

All rights, including translation, are served by the IEEE. Requests for republication permission should be addressed to the IEEE Editorial Department, 345 East 47th Street, New York, New York 10017. Abstracting is permitted with mention of source.

TABLE OF CONTENTS

DEVICES

Organizer and Moderator: P. Gary

The Mechanisms of Degradation in an Optically Coupled Isolator	
<i>E.F. Thomas</i>	1
The Reliability of Integrated Injection Logic Circuits for the Bell System	
<i>F.W. Hewlett, Jr. and R.A. Pederson</i>	5
A Study of Surface Charge Induced Inversion Failure of Junction Isolated, Monolithic Silicon Integrated Circuits	
<i>H.C. Potter and D.R. Reber</i>	11
Reliability Implications of Hot Electron Generation and Parasitic Bipolar Action in an IGFET Device	
<i>S.A. Abbas and E.E. Davidson</i>	18
A CMOS/SOS Reliability Study	
<i>J.S. Smith and D.D. Talada</i>	23
Microsurgery as a Tool in the Analysis of L.S.I. Silicon Chips	
<i>A. Loro</i>	33
Hot Electron Induced Degradation of N-Channel IGFETS	
<i>S.A. Abbas and R.C. Dockerty</i>	38

BONDING, METALLIZATION AND HYBRIDS

Organizer and Moderator: G. Harman

The Effect of Impurities on the Corrosion of Aluminum Metallization	
<i>W.M. Paulson and R.P. Lorigan</i>	42
Beryllium — A High Reliability Metalization	
<i>E.I. Hall, A. Koblinski, and J.E. Gragg, Jr.</i>	48
Gold Aluminum Interconnect Stability on Thin Film Hybrid Microcircuit Substrates	
<i>D.W. Bushmire</i>	55
Metallurgical Aspects of Aluminum Wire Bonds to Gold Metallization	
<i>J.L. Newsome, R.G. Oswald and W.R. Rodrigues De Miranda</i>	63
Investigation into Failures of Al Wires Bonded to Au Metallization in Microsubstrates	

<i>R. Kossowsky and A.I. Robinson</i>	75
Design and Use of a Laser Interferometer for Ultrasonic Bonding Studies	
<i>B.D. Martin</i>	82
The Use of Acoustic Emission in a Test for Beam Lead Bond Integrity	
<i>G.G. Harman</i>	86
An Evaluation of Silicon Damage Resulting From Ultrasonic Wire Bonding	
<i>Vern H. Winchell, II</i>	98

PRINTED CIRCUIT BOARDS AND CAPACITORS

Organizer and Moderator: G.H. Ebel

Accelerated Life Testing of Flexible Printed Circuits	
<i>P.J. Boddy, R.H. Delaney, J.N. Lahti, E.F. Landry and R.C. Restrirk</i>	108
Measurement of Thermo-Mechanical Strains in Plated-Through-Holes	
<i>H.H. Ammann and R.W. Jocher</i>	118
A Simple Model For The Thermo-Mechanical Deformations of Plated-Through-Holes in Multilayer Printed Wiring Boards	
<i>M.A. Oien</i>	121
Methods for Evaluating Plated-Through-Hole Reliability	
<i>M.A. Oien</i>	129
Measurement of Land to Plated-Through-Hole Interface Resistance in Multilayer Boards	
<i>J.N. Hines</i>	132
The Detection of Barrel Cracks in Plated-Through-Holes Using Four Point Resistance Measurements	
<i>D.A. Rudy</i>	135
Simulation of Thermal Stress Stimuli in The Testing of Printed Wiring Products	
<i>H.H. Ammann and I. Farkass</i>	141
A Study of Dielectric Absorption in Capacitors By Thermally Stimulated Discharge (TSD) Tests	
<i>J. Burnham, S.L. Webster, W. Simmons, J. Borough</i>	147
Non-Destructive X-Ray Inspection of Ceramic Chip Capacitors for Delaminations	
<i>R.S. Spriggs and A.H. Cronshagen</i>	157

PROMS

Organizer and Moderator: J. Cunningham

Fusing Mechanism of Nichrome-Linked Programmable Read-Only Memories Devices.	
<i>G.B. Kenney, W.K. Jones and R.E. Ogilvie</i>	164
Fusing Mechanism of Nichrome Thin Films	
<i>J.L. Davidson, J.D. Gibson, S.A. Harris and T.J. Rossiter</i>	173
Progress Report on NiCr Link PROM Reliability Studies	
<i>A.M. Marques, J. Partridge</i>	182
Developments in Dual Dielectric Charge Storage (DDC) REEPROM	
<i>D. Kahng</i>	192
Reliability Studies of Polysilicon Fusible Link PROMs	
<i>R.C. Smith, S. Rosenberg, C.R. Barrett</i>	193
FAMOS PROM Reliability Studies	
<i>G. Gear</i>	198
Electrically Shorted Semiconductor Junctions Utilized as Programmable Read-Only Memory Elements	
<i>W.R. Brockhoff</i>	202
A Reliability Assessment of Bipolar PROMs	
<i>P. Franklin</i>	207

ENCAPSULATION

Organizer and Moderator: N. Berglund

Dynamic Permeability Method for Epoxy Encapsulation Resins	
<i>N. Vanderkooi and M.N. Riddell</i>	219
A Study of Parasitic MOS Formation Mechanism in Plastic-Encapsulated MOS Devices	
<i>Y. Wakashima, H. Inayoshi, K. Nishi and S. Nishida</i>	223
Polyimide Passivation Reliability Study	
<i>A.J. Gregoritsch</i>	228
Thermally Stimulated Discharge Effects in Polymer Encapsulants	
<i>J. Woodard</i>	234

Extended Temperature Cycling of Plastic and Ceramic IC's
with Thermal Shock Preconditioning

W.T. Fitch 240

**TUTORIAL SESSION I: RELIABILITY TECHNOLOGY:
BASIC FAILURE ANALYSIS TECHNIQUES AND APPLICATIONS**

Organizer and Moderator: E.A. Doyle, Jr.

Basic Integrated Circuit Failure Analysis Techniques

Dale Platteter 248

Hermeticity and Particle Impact Noise Test Techniques

Ralph E. McCullough 256

An Improved Approach to Locating Pinhole Defects in MOS and
Bipolar Integrated Circuits Using Liquid Crystals

Carmine J. Salvo 263

Nondestructive SEM Studies of Localized Defects in Gate Dielectric Films of MIS Devices

O.K. Griffith, M.M.E. Beguwala, and R.E. Johnson 275

New Failure Analysis Techniques for Beam Lead and Multi-Level Metal INtegrated Circuits

John Spano 279

Microcircuit Package Gas Analysis

Robert W. Thomas 283

**TUTORIAL SESSION II: APPLICATIONS OF SURFACE ANALYTICAL
TECHNIQUES TO FAILURE ANALYSIS**

Organizer and Moderator: D. Muth

Surface Analysis ISS and SIMS

D.P. Smith 295

High Spatial Resolution Auger Electron Spectroscopy (AES) in a Diffusion-Pumped SEM

E.K. Brandis 296

The Use of High Energy Ion Beams For Surface and Thin Film Analysis

J.M. Poate 297

Auger Electron Spectroscopy

J.M. Morabito

Use of X-Ray Photoelectron Spectroscopy (ESCA)
for Chemical Diagnosis of Microelectronic Processing

Frank Grunthaner