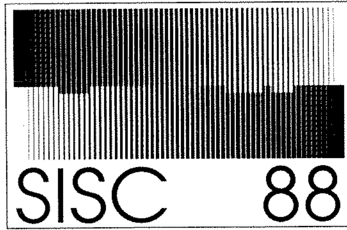


19th IEEE

# SEMICONDUCTOR INTERFACE SPECIALISTS CONFERENCE

December 7-10, 1988
San Diego Hilton Beach & Tennis Resort, San Diego, California

# PROFESSOR FRANK J. FEIGL

On November 26, 1988, Frank Feigl died suddenly in his home. He was 52 years old. Frank was a frequent participant at the Interface Specialists Conference beginning with the meeting in San Juan, and was on the organizing committee from 1982-85. He completed his Ph.D. degree at the University of Pittsburgh in 1965, studying defects in single crystal quartz by electron spin resonance. After postdoctoral studies at the University of Illinois he was appointed Assistant Professor of Physics and Member of the Materials Research Center at Lehigh University in 1967. He was promoted to Professor in 1976. With his Ph.D. students he extended the pioneering work of Dick Williams on electron trapping in silicon dioxide films utilizing internal photoemission.

Subsequent work consisted of the investigation of the phenomena of charge injection, trapping and detrapping in wide band gap insulating thin films. He simultaneously maintained a research program on the physics of point defects that resulted in widely accepted theoretical models of important defects in silicon dioxide materials. He was a Visiting Faculty Scientist at the IBM Watson Laboratory in 1979. He served Lehigh University as Coordinator of the Sherman Fairchild Laboratory during 1978-79, and as Chairman of the Physics Department from 1987 until his death. He also held a joint appointment as Professor of Electrical Engineering. He was a Fellow of the American Physical Society. As an advisor of research students, colleague in joint research programs, and member of the faculty, his hard work, wide scholarly interests, insight, and sense of humor will be deeply missed.

# 19th IEEE SEMICONDUCTOR INTERFACE SPECIALISTS CONFERENCE

## 1988 Technical Program

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M. White, Lehigh University, USA

Thursday Morning (8:30 - 12:10), December 8, 1988

**Session I: Local Atomic Structure of the $SiO_2$/Si Interface**

**Chairmen: R. C. Barker (Yale University) and A. Revesz (Revesz Associates)**

**I.1** **(Invited)** Microstructural Aspects of the Si/$SiO_2$ Interface
Jose Bevk (AT&T Bell Laboratories)

**I.2** Calculations of the $SiO_2$-Si Interface Based on the Ourmazd Model
A. X. Chu and W. B. Fowler (Lehigh University)

**I.3** HRTEM Observation of the Si/$SiO_2$ Interface
I. Ohdomari and H. Akatsu (Waseda University)

**I.4** An Initial Oxidation Study by High Energy Ion Scattering
J. Matsuo, A. Sato, N. Nakayama, and H. Ishikawa (Fujitsu Laboratory)

**I.5** Local Atomic Structure at Thermally Grown Si/$SiO_2$ Interfaces
J. T. Fitch and G. Lucovsky (North Carolina State University)

**I.6** Determination of Stress Effects in Thin Silicon Dioxide Films
P. E. Murray and G. F. Carey (The University of Texas)

**Session II (Poster): Oxidation & Novel Dielectric Structures**

**Chairman: Yasushiro Nishioka (Hitachi, Ltd.)**

**II.1** Effect of Si Surface Cleaning Procedures on Oxidation Mechanisms
J. M. deLarios, C. R. Helms (Stanford) D.-B. Kao, and B. E. Deal (Fairchild)

**II.2** Experimental Observation of a Delay in $SiO_2$ Growth at the Onset of the Thermal Oxidation of Silicon in Dry Oxygen
H. Z. Massoud (Duke University)

**II.3** Investigation of the Relation Between the Power Law Fit to Silicon Thermal Oxidation Kinetics and Structural Relaxation of the Oxide
R. W. Rendell, K. L. Ngai (Naval Research Labs) and E. H. Nicollian (U. of N. Carolina)

**II.4** Oxidation of Silicon with a 5 eV $O^-$ Beam
M. H. Hecht, O. J. Orient, A. Chutjian, and R. P. Vasquez (Jet Propulsion Lab/Caltech)

**II.5** Electrical Properties of $Y_2O_3/SiO_2$ and $Y_2O_3/Si_3N_4$ Stacked Dielectrics for Advanced DRAM Applications
I. C. Chen, B. W. Shen, J. Bohlman, C. W. Teng, and G. Brown (Texas Instruments)

**II.6** The Effects of HF-Enhanced Oxidation on the Mobilities of MOSFETs
L. Wei and X. Yuan-sen (Shanghai Institute of Metallurgy, China)

**II.7** Ultra-thin Thermal Nitride Interfacial Layers in Si Schottky Barriers
M. A. Sobolewski and C. R. Helms (Stanford)

Thursday Afternoon (2:00 - 5:40), December 8, 1988

**Session III: Interface State Characterization & Modeling**

**Chairmen: Roger DeKeersmaecker (IMEC, Belgium) & James Clemens (AT&T)**

**III.1** **(Invited)** Low-Temperature Electron Spin Resonance Study of $P_b$ Defects at Thermally-Grown $Si/SiO_2$ Interfaces
André Stesmans (Katholieke Universiteit Leuven, Belgium)

**III.2** Generation of $P_b$ Centers by Negative Corona Field Stress: An Electrochemical Model
G. J. Gerardi, M. Harmatz, W. R. Buchwald, and E. H. Poindexter (U. S. Army ET&D Labs)

**III.3** Model Calculations of Hydrogen Interactions with Dangling Orbital Defects at the <111> and <100> $Si/SiO_2$ Interfaces
A. H. Edwards ( U. S. Army ET&D Labs)

**III.4** Spin Dependent Generation-Recombination: A Study of $P_b$ Centers at the $Si/SiO_2$ Interface
M. A. Jupina and P. M. Lenahan (Pennsylvania State University)

**III.5** Thermally-Stimulated-Current Study of the $Si/SiO_2$ Interface
A. G. Revesz (Revesz Assoc.), Z. Shanfield (Northrop), and G. A. Brown (Texas Instruments)

**III.6** Annealing Chemistry of Defects at the $Si/SiO_2$ Interface and the Role that Non-Paramagnetic Centers Play
R. E. Stahlbush (Naval Research Labs), A. H. Edwards (U. S. Army ET&D Lab), and R. K. Lawrence (ARACOR)

**Session IV (Poster): Bulk and Interface Traps**

**Chairman: Eric Fossum (Columbia University)**

**IV.1** E' Centers and Positive Charge: Two Exceptions to the Rule
W. L. Warren, P. M. Lenahan (Pennsylvania State Univ.) and B. Robinson (IBM)

**IV.2** Rechargeable E' Centers in Silicon Dioxide Films
M. E. Zvanut, F. J. Feigl (Lehigh Univ.) and E. H. Poindexter, P. J. Caplan (U. S. Army ET&D Labs)

**IV.3** Observation of a Carbon Related Trap in $SiO_2$ Films
W. E. Carlos, R. E. Stahlbush, and H. B. Dietrich (Naval Research Labs)

**IV.4** Structural Evaluation of Plasma Deposited $SiO_2$
B. Robinson, F. R. McFeely (IBM) and W. L. Warren, P. M. Lenahan (Penn. State University)

**IV.5** Nature of the Dominant Deep Trap in Amorphous Silicon Nitride
D. T. Krick, P. M. Lenahan (Pennsylvania State Univ.) and J. Kanicki (IBM Watson)

**IV.6** Effect of Thermal Annealing in $TiSi_2$ Formation on $SiO_2$-Si Interface Properties
C-C. Wei, I-C. Chen, G. Brown, J. Tomlin, and J. Bohlman (Texas Instruments)

**IV.7** Deep Trench Structures in Silicon for Sensitivity Enhancement of $Si/SiO_2$ Interfaces
J. H. Stathis, E. Bassous, and B. A. Scott (IBM)

**Friday Morning (8:30 - 12:10), December 9, 1988**

**Session V: Radiation and Hot Carrier Effects (I)**

**Chairmen: Pieter Balk (Aachen Technical Univ. & DIMES, The Netherlands) and Paul Dressendorfer (Sandia National Labs)**

**V.1** **(Invited)** Interface States Generated by Electrons and Holes
Stephen Lyon (Princeton University)

**V.2** Mechanisms of Si-$SiO_2$ Interface State Generation During Carrier Injection
M. M. Heyns, D. K. Rao, R. F. De Keersmaeker (IMEC, Belgium)

**V.3** Enhanced Reaction Rate of Hydrogenic Holes in Device Oxides: The Fast and Slow Interface State Formation Mechanism?
B. B. Triplett (Intel), T. Takahashi, K. Yokogawa, and T. Sugano (U. of Tokyo)

**V.4** Model for the Dispersive Transport of $H^+$ in $SiO_2$ and its Role as the Rate Limiting Step in the Growth of Radiation Induced Interface States
D. B. Brown, N. S. Saks, and C. M. Dozier (Naval Research Labs)

**V.5** Defect Transformation Process at Radiation-Damaged (111) $Si/SiO_2$ Interface
Y. Wang, T. P. Ma, and R. C. Barker (Yale University)

**V.6** Damage Resistant Ultra-dry and Fluorinated Ultra-dry Gate Oxide
Y. Nishioka, Y. Ohji, R. Haruta, I. Yoshida, K. Mukai (Hitachi), T. Sugano (U. of Tokyo), Y. Wang, and T. P. Ma (Yale University)

**Session VI (Poster): Radiation and Hot Carrier Effects (II)**

**Chairman: George Brown (Texas Instruments)**

**VI.1** Slow State Creation in n-MOS Transistors by Hot Carrier Stressing
M. Bourcerie, B. S. Doyle, J-C. Marchetaux, J-C. Soret, & A. Boudou (BULL, S. A., France)

**VI.2** Electron Compensation Process for the Annealing of Trapped Holes in MOS Devices
A. J. Lelis, F. B. McLean, H. E. Boesch, and T. R. Oldham (Harry Diamond Lab)

**VI.3** Radiation Hardness Aging of Fluorinated $SiO_2$/Si Interface
X.-W. Wang, Y. Wang, D. Wang, and T. P. Ma (Yale University)

**VI.4** A Unified Model of Interface Charge Generation in Metal-Oxide-Silicon Structure Under Various Stress Conditions
N. Matsukawa (Hewlett-Packard)

**VI.5** Negative Gate-Bias Radiation Effects in MOS Structures
P. U. Kenkare and S. A. Lyon (Princeton University)

**VI.6** Radiation and Hot-Electron Hardened Si-gate MOSFET Utilizing F Implantation
Y. Nishioka, K. Ohyu, Y. Ohji, N. Natuaki, K. Mukai (Hitachi), and T. P. Ma (Yale University)

**Friday Afternoon (4:00 - 7:05), December 9, 1988**

**Session VII: Plenary Session on Advanced Materials for Novel Si Heterojunction Device Concepts**

**Chairman: Paula Grunthaner (Jet Propulsion Laboratory/Caltech)**

**Speaker: Eric Kasper**
**AEG Research Center Ulm, F. R. Germany**

**Topic:** Pseudomorphic SiGe/Si Interfaces: Strain, Band Offset, Modulation Doping

**Session VIII: Dielectric Reliability**

**Chairmen: Lalita Manchanda (AT&T Bell Labs) and Marvin White (Lehigh Univ.)**

**VIII.1** **(Invited)** Engineering Model of Defect-Induced Oxide Breakdown
Chenming Hu (University of California, Berkeley)

**VIII.2** Trap Creation in Silicon Dioxide Produced by Hot Electrons
D. J. DiMaria and J. W. Stasiak (IBM)

**VIII.3** Spectroscopic Investigation of Oxide States Responsible for Hot-Carrier Degradation
W. Weber, M. Brox, F. Hofmann, H. Huber, D. Jäger*, and D. Rieger (Siemens & *Institut für Angewandte Physik, FRG)

**VIII.4** A Study of Hot-Carrier Light Emission from Si MOS-Devices
M. Herzog and F. Koch (Technische Universität München, FRG)

<u>Saturday Morning (8:30 - 11:50), December 10, 1988</u>

**Session IX: Novel Electronic Characterization of Interfacial Defects**

**Chairmen: R. Daniel McGrath (Polaroid) and Robert Stahlbush (NRL)**

**IX.1** **(Invited)** Characterization of Individual Traps in $SiO_2$/Si
Max J. Schulz (University of Erlangen-Nürnberg, F. R. Germany

**IX.2** Individual Defects at the Si:$SiO_2$ Interface
M. J. Kirton, M. J. Uren, and S. Collins (RS&RE, United Kingdom)

**IX.3** Some Successes and Failures of the Charge Pumping Technique
N. S. Saks and M. G. Ancona (Naval Research Labs)

**IX.4** New Insights in the Charge Pumping Technique as a Tool for Probing Short Channel MOSFET Interface Properties and Degradation
P. Heremans, J. Witters, G. Groeseneken, H. E. Maes (IMEC, Belgium)

**IX.5** A Novel Approach to Extract the Density of Interface States from Charge Pumping Measurement: Experiment and Simulation
F. Hofmann and W. Hänsch (Siemens, F. R. Germany)

**IX.6** Accurate Measurement of Trivalent Silicon Interface Trap Density Using Small Signal Steady State Methods
J. A. Miller, C. Blat (U. of N. Carolina) and E. H. Nicollian (U. of N. Carolina and MCNC)