

**27th IEEE
Semiconductor
Interface
Specialists Conference**



December 5-7, 1996
The Catamaran Hotel, San Diego California, USA

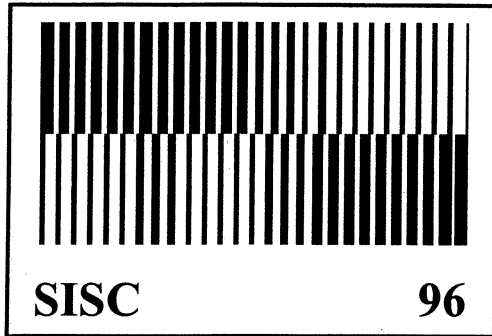
ABSTRACTS

General Chair : R.E. Stahlbush

Technical Chair : D.A. Buchanan

Arrangements Chair : L. Trombetta

The conference abstracts reproduced here are for the use of the attendees of this conference. THESE ABSTRACTS MAY NOT BE REFERENCED.



**27th IEEE
Semiconductor
Interface
Specialists Conference**



December 5-7, 1996, The Catamaran Hotel, San Diego California, USA

Executive Committee :

Robert E. Stahlbush
General Chair

Navel Research Laboratory
Washington D.C.

Douglas A. Buchanan
Technical Chair

IBM Watson Research Center
Yorktown Heights, NY

Lenny Trombetta
Arrangements Chair

University of Houston,
Houston, TX

William L. Warren
Ex-officio

Sandia National Laboratories
Aluquerque, NM

Program Commitee :

D. B. Brown

NRL, Washington, DC, USA

S. Cristoloveanu

ENSERG, Grenoble, France

K.R. Farmer

NJIT, Newark, NJ, USA

D.M. Fleetwood,

Sandia, Albuquerque, NM, USA

W.B. Fowler

Lehigh Univ., Bethlehem, PA, USA

E.A. Irene

UNC, Chapel Hill, NC, USA

A. Ishitani

NEC, Sahmihara, Japan

K.S. Krisch

Lucent - Bell Labs, Murray Hill, NJ, USA

T.P. Ma

Yale Univ., New Haven, CT, USA

H. Maes

IMEC, Leuven, Belgium

F.R. McFeely

IBM-Research, Yorktown Heights, NY, USA

M. Morita

Tohoku Univ., Sendai, Japan

M. Passlack

Motorola, Tempe, AZ, USA

J.H. Stathis

IBM-Research, Yorktown Heights, NY, USA

S. Taylor

Univ. Liverpool, Liverpool, England

A. Toriumi

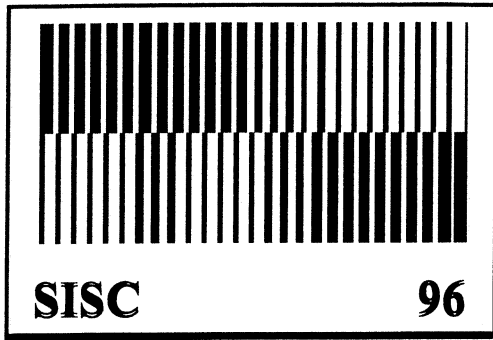
Toshiba Corp., Kawasaki, Japan

SISC Ed Nicollian Award for Best Student Paper

This year the SISC is continuing with the *SISC Ed Nicollian Best Student Paper Award*. This award was started in 1995 to honor the memory Prof. E. H. Nicollian who was a pioneer in the exploration of metal oxide semiconductor (MOS) systems. His contributions were fundamental to establishing the SISC in its early years and he served as the Technical Chair in 1982. With John Brews, he wrote the definitive book about interface and near-interface defects in MOS devices measured by capacitance-voltage techniques.

SISC Ed Nicollian Best Student Paper Award is presented to the best paper presented by a student at the Semiconductor Interface Specialists Conference. To be eligible, the student must be the lead author and give the oral or poster presentation. At the end of the conference, after all papers have been given, the program committee votes for the best student presentation. The award, consisting of a plaque and an honorarium, are presented to the recipient after the conference. The winner from the 1995 SISC was K. A. Ellis, for his paper "*Gas Phase Chemistry of N₂O Furnace Oxidation*", by K.A. Ellis and R.A. Buhrman, School of Applied and Engineering Physics, Cornell University.

Those wishing to be considered for the 1996 award should make themselves known to the Technical Chair.



**27th IEEE
Semiconductor
Interface
Specialists Conference**



December 5-7, 1996

The Catamaran Hotel, San Diego California, USA

SESSION 1 - Silicon Carbide

Thursday December 5, 1996 8:00 AM -9:50 AM

Session Chair : D.M. Fleetwood

- 8:00 AM **Opening Remarks**
- 8:10 AM 1.1 **Electron Transport at the SiC/SiO₂ Interface (Invited), T.Ouisse,**
Laboratoire de Physique des Composants à Semiconducteurs (LPCS), UMR-
CNRS 5531, ENSERG, Grenoble, France.
- 8:50 AM 1.2 **Charge Pumping Measurements on 6H-SiC MOSFETs, M.J. Kivi¹, S.**
Taylor¹ and L.A. Lipkin², ¹Department of Electrical Engineering and
Electronics, Liverpool University, Liverpool, UK, ²Cree Research Inc.,
Durham, NC USA.
- 9:10 AM 1.3 **Termination of Dangling Bond Defects at SiC-SiO₂ Interfaces, A. Gözl¹,**
G. Lucovsky², K. Koh², D. Wolfe² and H. Kurz¹, ¹Institut für
Halbleitertechnik, RWTH-Aachen, Germany, ²Department of Materials
Science and Engineering, Physics, Electrical and Computer Engineering,
North Carolina State University, Raleigh, NC USA.
- 9:30 AM 1.4 **6H-SiC/SiO₂ Interface Degradation Caused by Electron Injection in the**
Oxide, V.V. Afanas'ev¹, M. Bassler², G. Pensl² and M.J. Schultz²,
¹Department of Physics, University of Leuven, Belgium, ²Institute of
Applied Physics, Univeristy of Erlangen-Nurnberg, Erlangen, Germany.



27th IEEE Semiconductor Interface Specialists Conference



December 5-7, 1996

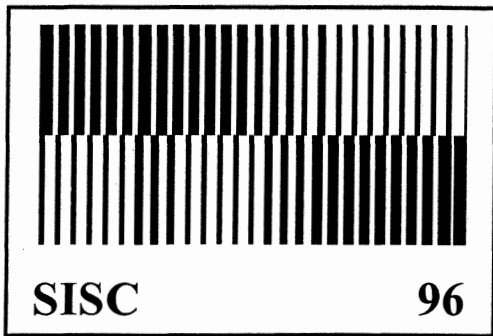
The Catamaran Hotel, San Diego California, USA

POSTERS P1.1-P1.6

Thursday December 5, 1996 9:50 AM -10:11 AM

Session Chairs : S. Taylor and M. Passlack

- 9:50 AM P1.1 **Comparing SiO₂ Grown on Aluminum or Boron Doped p-type SiC**, L.A. Lipkin¹ J.W. Palmour¹ and J.S. Suehle², ¹Cree Research Inc, Durham, NC USA, ²NIST, Gaithersburg, MD USA.
- 9:53 AM P1.2 **Reliability Properties of Ultra-thin Oxide Layers Subjected to Fowler-Nordheim Tunnelling Current Stress**, A. Scarpa^{1,2,3}, G. Ghibaudo¹, G. Ghidini², G. Pananakakis¹, and A. Paccagnella³, ¹Laboratoire de Physique des Composants à Semiconducteurs, ENSERG, Grenoble, France, ²SGS-Thomson Microelectronics, Central R&D, Agrate Brianza Italy, ³Dipartimento di Elettronica e Informatica, Università di Padova, Padova, Italy.
- 9:56 AM P1.3 **Superior Characteristics of Low Temperature-Grown Ultrathin (3 nm) Oxides with Post Oxidation Annealing**, M. Matsumura, T. Sakoda, T. Komeda and Y. Nishioka, Texas Instruments Tsukuba R&D Center Ltd., Tsukuba, Ibaraki, Japan.
- 9:59 AM P1.4 **Lateral Distributions of Erase-Induced Hole Trapping and Interface Traps in Flash EPROM/NMOSFET Devices**, C. Chen and T.P. Ma, Center for Microelectronic Materials Structures, Dept. of Electrical Engineering, Yale University, New Haven CT USA.
- 10:02 AM P1.5 **Leakage Currents in Ultra-thin Silicon Nitride/Oxide Dielectric Stack**, Y. Shi¹, X.W. Wang¹, T.P. Ma¹, G.J. Cui², T. Tamagawa², B.L. Halpern² and J.J. Schmitt², ¹Dept. of Electrical Engineering, Yale University, New Haven CT USA, ²Jet Process Corporation, New Haven CT USA.
- 10:05 AM P1.6 **Endurance Characteristics of Rapid Thermal Chemical Vapor Deposited Tunnel Dielectrics Annealed in N₂O for EEPROM Applications**, B.E. Hornung, H.H. Heinisch, S.A. Craig and J.J. Wortman, North Carolina State University, Raleigh, NC USA.
- 10:08 AM **BREAK**



**27th IEEE
Semiconductor
Interface
Specialists Conference**

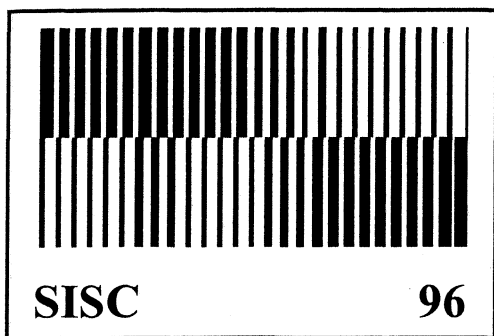


December 5-7, 1996

The Catamaran Hotel, San Diego California, USA

SESSION 2 - Monte Carlo / Theory
Thursday December 5, 1996 10:45 AM -12:45 AM
Session Chair : M. Morita and A. Toriumi

- 10:45 AM 2.1 **Monte Carlo Simulation of MOS Devices (Invited)**, M.V. Fischetti and S.E. Laux, IBM Research Division, T.J. Watson Research Center, Yorktown Heights, NY USA.
- 11:25 AM 2.2 **Monte Carlo Simulation of Electron Transport Properties of Quantized Silicon Carbide Inversion Layers**, J.B. Roldán F. Gámiz, J.A. López-Villanueva, and P. Cartujo, Departamento de Electrónica y Tecnología de Computadores, Universidad de Granada, Granada, Spain.
- 11:45 AM 2.3 **Quantum Mechanical Calculation of Capacitance and Tunneling Current of Ultra-thin Gate Oxides with Experimental Verification**, S-H. Lo, D.A. Buchanan, Y. Taur and W-K. Wang, IBM Thomas J. Watson Research Center, Yorktown Heights, NY USA.
- 12:05 PM 2.4 **Theory of Si- and C- P_b Centers on the (111) Interfaces of β -SiC-SiO₂ System**, A.H. Edwards¹, W.B. Fowler², Department of Electrical Engineering, University of North Carolina at Charlotte, Charlotte, NC USA, ²Department of Physics and the Sherman Fairchild Laboratory, Lehigh University, Bethlehem, PA USA.
- 12:25 PM **LUNCH**



**27th IEEE
Semiconductor
Interface
Specialists Conference**



December 5-7, 1996

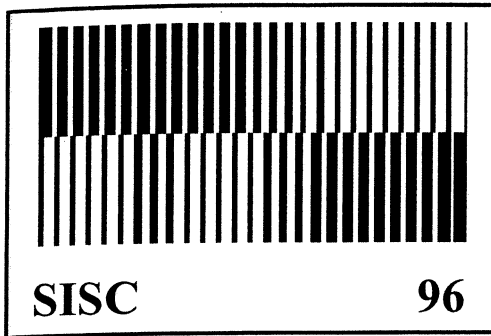
The Catamaran Hotel, San Diego California, USA

SESSION 3 - Oxide Degradation and Defects

Thursday December 5, 1996 2:00 PM - 4:00 PM

Session Chair : K.R. Farmer

- 2:00 PM 3.1 **New Insights in the Impact of the Breakdown Mechanisms on the Statistics of Intrinsic and Extrinsic Breakdown in Thin Oxides (Invited), G. Groeseneken, R. Degraeve, J.-L. Ogier, R. Bellens, Ph. Roussel, M. Depas and H.E. Maes, IMEC, Leuven, Belgium.**
- 2:40 PM 3.2 **Dependence of MOS Oxide Charging and Hole Currents on Poly-Si-Gate-Work-Function, D.J. DiMaria, IBM-Research Division, T.J. Watson Research Center, Yorktown Heights, NY USA.**
- 3:00 PM 3.3 **Apparent Annihilation of Interface Traps by Hot-Carrier Injection, Y. Li and T.P. Ma, Dept. of Electrical Engineering, Yale University, New Haven CT USA.**
- 3:20 PM 3.4 **Enhanced Low-Rate Radiation-Induced Charge Trapping at the Emitter-Base/Oxide Interface of Bipolar Devices, D.M. Fleetwood¹ and R.D. Schrimpf², ¹Sandia National Laboratories, Albuquerque, NM USA, ²Dept. of Electrical and Computer Engineering, Tucson, AZ USA.**
- 3:40 PM 3.5 **Electron and Hole Trap Formation in Buried Thermal Oxide Caused by 1100 to 1325°C Annealing, R. E. Stahlbush, Naval Research Laboratory, Washington, DC USA.**
- 4:00 PM **BREAK**



**27th IEEE
Semiconductor
Interface
Specialists Conference**



December 5-7, 1996

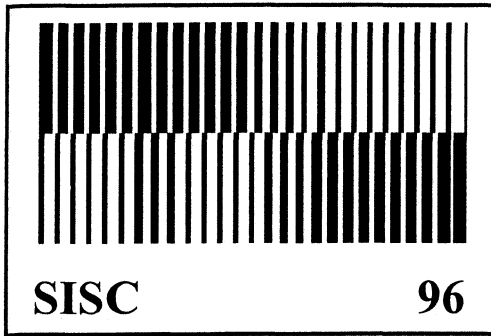
The Catamaran Hotel, San Diego California, USA

POSTERS P3.1-P3.5

Thursday December 5, 1996 4:30 PM - 4:45 PM

Session Chairs : W.B. Fowler and D.B. Brown

- 4:30 PM P3.1 **Initial Stages of Si-SiO₂ Interface Formation by Rapid Thermal Oxidation in O₂ and N₂O by On-Line Auger Electron Spectroscopy (AES)**, K. Koh, H. Yang, H. Niimi and G. Lucovsky, Department of Materials Science and Engineering, Physcis, Electrical and Computer Engineering, North Carolina State University, Raleigh, NC USA.
- 4:33 PM P3.2 **Determination of Ultra-Thin Oxide Voltages and Thickness for Dual-Gate Poly FET Structures**, E. Wu¹, S-H. Lo², A. Acovic¹, and D.A. Buchanan², ¹IBM Microelectronics Division, Essex Junction, VT USA, ²IBM T. J. Watson Research Center, Yorktown Heights, NY USA.
- 4:36 PM P3.3 **Degradation and Nitridation Dependence of Steady-State Stress Induced Leakage Current (SILC)**, J. De Blauwe, R. Degraeve, R. Bellens, J. Van Houdt, G. Groeseneken, H. E. Maes, IMEC, Leuven, Belgium.
- 4:39 PM P3.4 **Cathode and Anode Traps in High-Voltage Stressed Silicon Oxides**, L. Chen¹, C-S. Kang², D.J. Dumin¹, G.A. Brown³, P. Bellutti⁴, ¹Center for Semiconductor Device Reliability Research, Department of Electrical and Computer Engineering, Clemson University, Clemson, SC USA, ²Semiconductor Process Laboratory, Texas Instruments, Inc., Dallas, TX USA, ³Istituto per la Ricerca Scientifica e Tecnologica, Trento, Italy, ⁴Department of Electronic Engineering Yuhan College, Kyungki-Do, Korea.
- 4:42 PM P3.4 **Quasi-Breakdown in Ultra-Thin Gate Dielectrics**, A. Halimaoui¹, O. Brière^{1,2}, Y. Chroboczek¹, and G. Ghibaudo³, ¹France Télécom, CNET, Meylan, France, ²Matra MHS TEMIC, La Chantrerie, Nantes, France, ³LPCS, Grenoble, France.



**27th IEEE
Semiconductor
Interface
Specialists Conference**



December 5-7, 1996

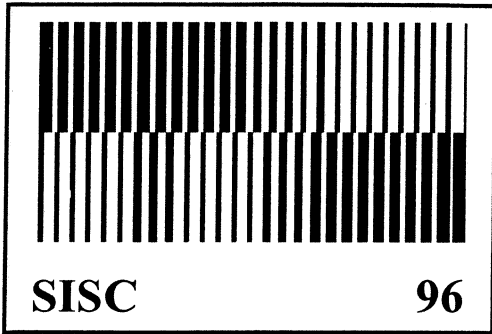
The Catamaran Hotel, San Diego California, USA

SESSION 4 - TFT's and Hetrostructures

Thursday December 5, 1996 4:45-5:45 PM

Session Chair : T.P. Ma

- 4:45 PM 4.1 **New Experimental Technique for Evaluating Band Discontinuity - Application of Admittance Spectroscopy to MOS Capacitors Fabricated on Si/Si_{1-x}Ge_x/Si Heterostructures**, S-i Takagi¹, J.L. Hoyt², K. Rim², J.J. Wesler² and J.F. Gibbons², ¹ ULSI Research Lab, Toshiba Corp., ²Solid State Electronics Lab, Stanford University, Stanford CA USA.
- 5:05 PM 4.2 **Effect of Interface Roughness on the Performance of Poly-Si TFT Fabricated by Novel Oxidation Method**, J-H. Jeon, C-M. Park, B-H, Min and M-K. Han, School of Engineering, Seoul National University, Seoul, Korea.
- 5:25 PM 4.3 **The Characteristics of Oxide on Poly-Si Structure Fabricated by Excimer Laser Irradiation**, C-M. Park, B-H, Min, J-H., Jun, J-S. Yoo, and M-K. Han, School of Engineering, Seoul National University, Seoul, Korea.



27th IEEE
Semiconductor
Interface
Specialists Conference



December 5-7, 1996

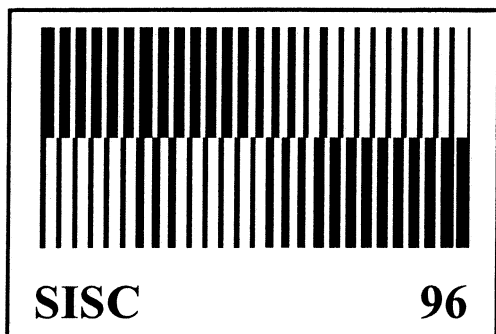
The Catamaran Hotel, San Diego California, USA

POSTERS P4.1-P4.5

Thursday December 5, 1996 5:45 PM - 6:00 PM

Session Chair : S. Cristoloveanu and D.A. Buchanan

- 5:45 PM P4.1 **Interaction of H/H⁺ with *a*-SiO₂: An *ab initio* Quantum Chemical Study**, S.P. Karna¹, A.M. Ferreira¹, R.D. Pugh¹, C.P. Brothers¹, B.K. Singaraju¹, W.L. Warren² and K. Vanheusden², ¹US Air Force Phillips Laboratory, Space Electronics Division, Kirtland Air Force Base, NM USA, ²Sandia National Laboratories, Albuquerque, NM USA.
- 5:48 PM P4.2 **Trapping Centers in Unibond[®] Buried Oxides**, B.D. Wallace¹, P.M. Lenahan¹, and J.F. Conley, Jr.², ¹The Pennsylvania State University, Department of Engineering Science and Mechanics, University Park, PA, ²Dynamics Research Corporation, Commercial Systems, Beaverton, OR USA.
- 5:51 PM P4.3 **Profiling of Both Oxide Charge and Interface States in MOSFET under Various Bias Stress Conditions**, S-M. Cheng, C-M. Yih, C-C. Yeh, S-N. Kuo, and S.S. Chung, Department of Electronics Engineering and Institute of Electronics, National Chiao Tung University, Hsinchu, Taiwan, Republic of China.
- 5:54 PM P4.4 **Correlating LDD nMOSFET Hot Carrier Degradation with a Microstructural Model for Interface Traps**, R. J. Milanowski¹, M. P. Pagey¹, and E. S. Snyder², ¹Dept. of Electrical and Computer Engineering, Vanderbilt University, Nashville, TN USA, ²Sandia Technologies, Albuquerque, NM USA.
- 5:57 PM P4.5 **Numerical Simulation of Hydrogen Redistribution in Thin SiO₂ Films Under Electron Injection in High Fields**, G. Gadiyak, Institute of Computational Technologies, Russian Academy of Sciences Siberian Division, Novosibirsk, Russia.



**27th IEEE
Semiconductor
Interface
Specialists Conference**



December 5-7, 1996

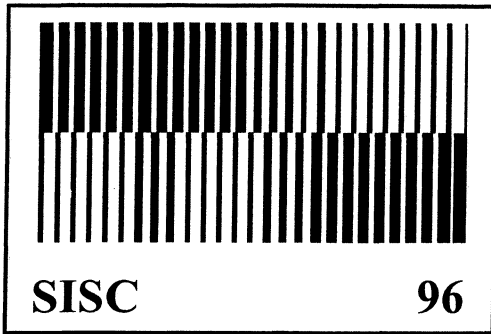
The Catamaran Hotel, San Diego California, USA

SESSION 5 - Oxide and Interface Characterization

Friday December 6, 1996 8:30 AM - 10:30 AM

Session Chair : A. Ishitani

- 8:30 AM 5.1 **Application of Femtosecond Lasers to Nonlinear Spectroscopy and Process Monitoring of Si(001) Interfaces (Invited)**, M.C. Downer, J.I. Dadap, X.F. Xu, P.T. Wilson, M.H. Anderson, M. ter Beck, O.A. Akisipetrov, E.D. Mishina, N.M. Russell and J.G. Ekerdt, Center for Synthesis, Growth and Analysis of Electronic Materials, University of Texas at Austin, Austin, TX USA.
- 9:10 AM 5.2 **A Slow Trap Profiling Technique for MOS Structure Characterization**, Dimitrijevic, P. Tanner and H.B. Harrison, School of Microelectronic Engineering, Griffith University, Nathan, Queensland, Australia.
- 9:30 AM 5.3 **Electronic Structure of Pb Centers at the (100), (111) and (110) Si/SiO₂ Interfaces**, J. H. Stathis and E. Cartier, IBM Research Division, Yorktown Heights, NY USA.
- 9:50 AM 5.4 **Quantum Electrical Measurements of SiO₂/Si Roughness in MOS Transistors**, C.A. Richter¹ and W.R. Anderson², ¹Semiconductor Electronics Division, National Institute of Standards and Technology, Gaithersburg, MD USA, ²Digital Semiconductor, Digital Equipment Corporation, Hudson, MA USA.
- 10:10 AM 5.5 **Light Emission during Direct and Fowler-Nordheim Tunneling in Ultra Thin MOS Tunnel Junctions**, E. Cartier, J.C. Tsang, M.V. Fischetti, and D.A. Buchanan, IBM Research Division, T. J. Watson Research Center, Yorktown Heights, NY USA.
- 10:30 AM **BREAK**



**27th IEEE
Semiconductor
Interface
Specialists Conference**



December 5-7, 1996

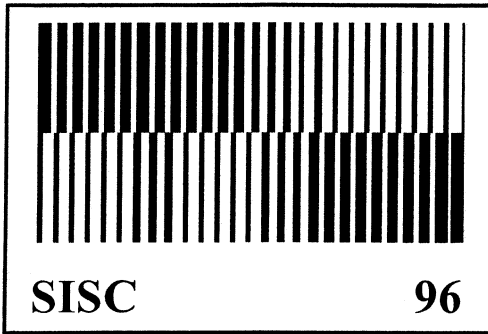
The Catamaran Hotel, San Diego California, USA

SESSION 6 - N₂O growth and characterization

Friday December 6, 1996 11:00 AM-12:40 PM

Session Chair : R.E. Stahlbush

- 11:00 AM 6.1 **Nitrogen Behaviour during the Thermal Growth of Silicon Oxynitride Films on Si in N₂O**, I.-J. Ganem¹, I. Trimaille¹, S. Rigo¹, I.J.R. Baumvol² and F.C. Stedile², ¹Groupe de Phys. des Solides, Universit s Paris 6 et 7, Paris, France, ²Instituto de Fisica and Quimica, UFRGS, Porto Alegre, Brazil.
- 11:20 AM 6.2 **High Resolution Depth Profiling of Ultrathin Silicon Oxynitrides**, H.C. Lu¹, E.P. Gusev¹, T. Gustafsson¹, E. Garfunkel¹, D. Brasen², and M.L. Green², ¹Departments of Physics and Chemistry, and Laboratory for Surface Modification, Rutgers University, Piscataway, NJ USA, ²Bell Laboratories Lucent Technologies, Murray Hill, NJ USA.
- 11:40 AM 6.3 **Growth and Reliability of 3 nm N₂O Gate Oxide**, T Nigam, .M. Depas and M.M. Heyns, IMEC, Leuven, Belgium.
- 12:00 PM 6.4 **Effect of Nitrogen Implantation on Gate Oxide Reliability**, Chuan Lin¹, A.I. Chou¹, B. Doyle², H.R. Soleimani³, and J.C. Lee¹, ¹Microelectronics Research Center, University of Texas, Austin, TX USA, ²Intel Corporation, Santa Clara, CA USA, ³Digital Equipment Corporation, ULSI Operations Group, Hudson, MA USA.
- 12:20 AM 6.5 **Boron Diffusion in Gate Oxynitrides**, K.A. Ellis and R.A. Buhrman, School of Applied and Engineering Physics, Cornell University, Ithaca, NY USA.



**27th IEEE
Semiconductor
Interface
Specialists Conference**



December 5-7, 1996

The Catamaran Hotel, San Diego California, USA

SESSION 7 - Deuterium and Hydrogen

Saturday December 7, 1996 8:30 AM - 10:10 AM

Session Chair : K.S. Krisch

- 8:30 AM 7.1 **STM Nanofabrication and Deuterium Post Metal Annealing of MOSFETs for Improved Hot Carrier Reliability (Invited), J.W. Lyding¹, K. Hess¹ and I.C. Kizilyalli², ¹Dept. of Electrical and Computer Engineering and Beckman Institute, University of Illinois at Urbana-Champaign, Urbana, IL USA, ²Bell Laboratories, Lucent Technologies, Orlando, FL USA.**
- 9:10 AM 7.2 **On the Behavior of Deuterium in Ultrathin SiO₂ Films upon Thermal Annealing, I.J.R. Baumvol¹, F.C. Stedile², F.L. Freire Jr.³, E.P. Gusev⁴, M.L. Green⁵, and D. Brasen⁵, ¹Instituto de Fisica, ²Instituto de Quimica-UFRGS, Porto Alegre, Brazil, ³Departamento de Fisica, PUC-Rio, Brasil, ⁴Depts. of Chemistry and Physics, Rutgers University, Piscataway, NJ, USA, ⁵Bell Laboratories Lucent Technologies, Murray Hill, NJ, USA.**
- 9:30 AM 7.3 **Temperature Dependent Electron Capture by Protons (H⁺) in SiO₂ Thin Films, K. Vanheusden,¹ W.L. Warren¹, D.M. Fleetwood¹, and R.A.B. Devine², ¹Sandia National Laboratories, Albuquerque, New Mexico, USA, ²France Telecom/CNET, Meylan Cedex, France.**
- 9:50 AM 7.4 **Creation of P_b Interface Defects in Thermal Si/SiO₂ through Annealing: Interface Degradation Mechanism, A. Stesmans and V.V. Afanas'ev, Department of Physics, University of Leuven, Leuven, Belgium.**
- 10:10 AM **BREAK**



**27th IEEE
Semiconductor
Interface
Specialists Conference**



December 5-7, 1996

The Catamaran Hotel, San Diego California, USA

SESSION 8 - Thin Oxide

Saturday December 7, 1996

Saturday December 7, 1996 10:40 AM - 12:30 AM

Session Chair : H. Maes

- 10:40 AM 8.1 **Thin Gate Dielectrics for Future CMOS Applications (Invited)**, H.S. Momose, S-i. Nakamura, Y. Katsumata and H. Iwai, Toshiba Corporation, Kawasaki, Japan.
- 11:20 AM 8.2 **Relationship Between Positive Charge and Breakdown in Sub-3.5 nm Oxides on Silicon**, K.R. Farmer¹, C.P. Debauche^{1,2}, W.R. Buchwald² and D.A. Buchanan³, ¹Dept. of Physics, New Jersey Institute of Technology, Newark, NJ USA, ²U.S. Army Research Laboratory, Ft. Monmouth, NJ USA, IBM-Research Division, T.J. Watson Research Center, Yorktown Heights, NY USA.
- 11:40 PM 8.3 **Fluctuations of Tunneling Current in the Direct Tunneling Regime**, G.B. Alers, K.S.Krisch, D. Monroe and B.E. Weir, Bell Laboratories, Lucent Technologies, Murray Hill, NJ USA.
- 12:00 PM 8.4 **Stacked RTCVD Oxide and Oxynitride Films for Ultrathin Gate Dielectrics**, E.M. Vogel¹, W.K. Henson¹, P.K. McLarty², J.J. Wortman¹, J.R. Hauser¹, ¹Department of Electrical and Computer Engineering, North Carolina State University, Raleigh, NC USA, ²Texas Instruments Inc., Dallas, TX USA.
- 12:20 **CLOSING REMARKS**