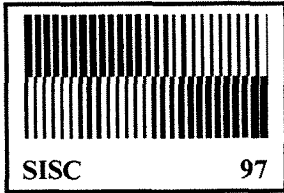


28th IEEE Semiconductor Interface Specialists Conference

December 4 - 6, 1997
The Mills House Inn, Charleston, South Carolina

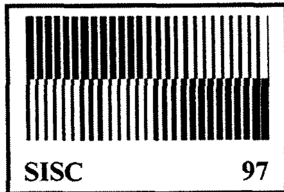
ABSTRACTS

General Chair: D. A. Buchanan

Technical Chair: L. P. Trombetta

Arrangements Chair: D. M. Fleetwood

The abstracts reproduced here are for the use of SISC attendees. To encourage future participants to submit new, unpublished work, the conference policy is that *the abstracts may not be referenced.*



28th IEEE Semiconductor Interface Specialists Conference

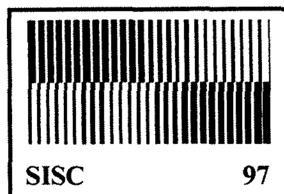
December 4 - 6, 1997
The Mills House Inn, Charleston, South Carolina

Executive Committee

D. A. Buchanan, *General Chair*	IBM T. J. Watson Research Center Yorktown Heights, NY USA
L. Trombetta, *Technical Chair*	University of Houston Houston, TX USA
D. Fleetwood, *Arrangements Chair*	Sandia National Laboratories Albuquerque, NM USA
R. E. Stahlbush, *Ex-Officio*	Naval Research Laboratories Washington, DC USA

Program Committee

D. B. Brown	NRL, Washington, DC USA
J. R. Cooper	Purdue Univ., West Lafayette, IN USA
S. Cristoloveanu	ENSERG, Grenoble, France
K. R. Farmer	NJIT, Newark, NJ USA
W. B. Fowler	Lehigh Univ., Bethlehem, PA USA
M. Hirose	Hiroshima Univ., Higashi-Hiroshima 739, Japan
E. A. Irene	UNC, Chapel Hill, SC USA
K. S. Krisch	Lucent Technologies, Murray Hill, NU USA
T. Kubota	NEC, Kanagawa, Japan
G. Lucovsky	NC State, Raleigh, NC USA
H. Maes	IMEC, Leuven, Belgium
F. R. McFeely	IBM Research, Yorktown Heights, NY USA
M. Passlack	Motorola PCRL, Tempe, AZ USA
S. Taylor	Univ. of Liverpool, Liverpool, UK
A. Toriumi	Toshiba, Kawasaki, Japan
M. E. Zvanut	UA Birmingham, Birmingham, AL



28th IEEE Semiconductor Interface Specialists Conference

December 4 - 6, 1997
The Mills House Inn, Charleston, South Carolina

Session 1: Interface Traps

Thursday, Dec. 4, 1997

Session Chair: D. Buchanan, IBM T. J Watson Research Center

8:00 AM **Opening Remarks**

8:10 AM 1.1 ***Invited*** **Characterizing Individual Interface Traps with Charge Pumping** Nelson Saks, (Naval Research Labs, Washington, DC)

8:50 AM 1.2 **Analysis of Charge Pumping Characteristics of Single Interface Traps** P. Habaš[1,2], I. De Wolf[1], G. Groeseneken[1], A. Stesmans[3], and H. E. Maes[1] ([1]IMEC, Leuven, Belgium; [2]Inst. for Solid State Electronics, Vienna, Austria; [3]Dept. of Physics, K. U. Leuven, Belgium)

9:10 AM 1.3 **Hydrogen Cracking in SiO_2: Chemical Kinetics for H_2 Dissociation at Silicon Dangling Orbitals** H. A. Kurtz (Dept. of Chemistry, Univ. of Memphis, TN), A. H. Edwards (Dept. of Electrical Engineering, UNC Charlotte), S. P. Karna, R. D. Pugh, W. Shedd, and B. K. Singaraju (USAF Phillips Laboratory, KAFB, NM)

9:30 AM 1.4 **Atomic-Scale Dynamics During Oxidation and the Nature of Defects at the Si-SiO_2 Interface** Sokrates T. Pantelides and Madhave Ramamoorthy[1], (Dept. of Physics and Astronomy, Vanderbilt Univ., Nashville, TN; [1]Present address Dept. of Physics, NC State Univ., Raleigh, NC)

9:50 AM **Break**

Session 2: Silicon Carbide

Thursday, Dec. 4, 1997

Session Chair: J. Cooper, Purdue University

10:20 AM 2.1 ***Invited*** **Present Status of Oxides on SiC** John Palmour (Cree Research, Durham, NC)

11:00 AM 2.2 **Long Term Reliability of Thermally Grown SiO_2 on 6H-SiC** Michelle Mathur Maranowski and James A. Cooper Jr. (School of Electrical and Computer Engineering, Purdue Univ., IN)

11:20 AM 2.3 **A Heat-Treatment-Induced Defect in Oxidized SiC** P. M. MacFarlane and M. E. Zvanut (Univ. Alabama at Birmingham)

Poster Presentations I

Thursday, Dec. 4, 1997

Session Chair: S. Taylor, University of Liverpool

11:40 AM P1.1 **Detailed Study of the Parasitic Geometric Current Component in Charge Pumping Measurements: Determination of Relevant Parameters** P. Habaš[1,2], G. Groeseneken[1], G. Van den Bosch[1], H. E. Maes[1], and E. Gornik[2] ([1]IMEC, Leuven, Belgium; [2]Inst. for Solid State Electronics, Vienna, Austria)

11:43 AM P1.2 **Hot Hole Induced Degradation of Oxynitrides** H. K. Sii, J. F. Zhang (School of Engineering, Liverpool John Morres Univ., UK), and G. Groeseneken (IMEC, Leuven, Belgium)

11:46 AM P2.1 **Temperature Dependence of Subthreshold Currents in 6H-SiC MOSFETs** S. Taylor, I. Al-Kofahi (Dept. of Electrical Engineering and Electronics, Liverpool Univ., UK), and L. A. Lipkin (Cree Research Inc., Durham, NC)

11:49 AM P2.2 **Influence of the Defects of the SiO_2/β-SiC Interface on the Electron Transport Properties in Quantized β-SiC Layers** G. Gámiz, J. B. Roldán, J. A. López-Villanueva, P. Cartujo, and J. E. Carceller (Departamento de Electrónica y Tecnología de Computadores, Univ. de Granada, Spain)

11:52 AM P2.3 **Chemical and Compositional Analysis of the SiO_2/SiC Interface by X-ray Photoelectron Spectroscopy and Sputter Depth Profiling** G. G. Jernigan[1], R. E. Stahlbush[1], L. Lipkin[2], M. Das[3], and J. Cooper[3] ([1]Naval Research Laboratory, Washington, DC; [2]Cree Research, Inc., Durham, NC; [3]School of Electrical and Computer Engineering, Purdue Univ., W. Lafayette, IN)

11:55 AM P3.1 **Photoluminescence Study of SIMOX Buried Oxide** H. Nishikawa, J. H. Stathis (IBM T.J. Watson Research Center, Yorktown Heights, NY), and R. E. Stahlbush (Naval Research Laboratory, Washington, DC)

11:58 AM P3.2 **Annealing and Sacrificial Oxidation-Induced Modifications of the Properties of Thin SOI Films** D. Munteanu[1], C. Guilhalmenc[2], S. Cristoloveanu[1], H. Moriceau[2], and B. Aspar[2] ([1]LPCS, ENSERG, Grenoble, France; [2]LETI-Dépt. Microtechnologies/CEA-Grenoble, France)

12:01 PM P4.1 **Ferroelectric Memory Capacitor on Si with Ultra-thin Silicon Nitride Buffer Layer** Jinping Han, Xin Guo, and T. P. Ma (Dept. of Electrical Engineering, Yale Univ., New Haven, CT)

12:04 PM P4.2 **The Use of RTCVD Oxynitrides in Ultra-thin Gate Dielectric Stacks** E. M. Vogel, J. J. Wortman, and J. R. Hauser (Dept. of Electrical and Computer Engineering, NC State Univ., NC)

12:07 PM P4.3 **Characterization of Ta_2O_5/Oxynitride Stacked Gate Insulator Structures** S. C. Sun[1,2] and Y. L. Huang[2] ([1]Taiwan Semiconductor Manufacturing Co., Taiwan, ROC; [2]Inst. of Electronics, National Chiao Tung Univ., Taiwan, ROC)

Session 3: Silicon-On-Insulator (SOI)

Thursday, Dec. 4, 1997

Session Chair: S. Cristoloveanu, LPSC, ENSERG, Grenoble, France

2:00 PM 3.1 **H^+ Motion in Buried Oxides: Comparison of Hydrogen-Annealing-Induced and Radiation-Induced Mobile Charge** R. E. Stahlbush (Naval Research Laboratory, Washington, DC) and R. K. Lawrence (ARACOR, Washington, DC)

2:20 PM 3.2 **Generation Kinetics and Thermal Stability of Mobile Protons in SiO_2 Thin Films** K. Vanheusden[1], W. L. Warren[2], L. B. Archer[3], D. M. Fleetwood[2], R. A. B. Devine[4], B. L. Draper[2], J. R. Schwank[2], M. R. Shaneyfelt[2], P. S. Winokur[2], and R. M. Wallace[3] ([1]USAF Phillips Laboratory, KAFB, NM; [2]Sandia National Laboratories, Albuquerque, NM; [3]Texas Instruments, Inc., Dallas, TX; [4]France Telecom/CNET, Meylan Cedex, France)

2:40 PM 3.3 **Theoretical Study of Protons in Buried Oxides** A. H. Edwards[1], S. P. Karna[2], W. B. Fowler[3], K. Vanheusden[2], W. L. Warren[4], R. A. B. Devine[5], R. D. Pugh[2], W. Shedd[2], and B. K. Singaraju[2] ([1]Dept. of Electrical Engineering, UNC Charlotte, NC; [2]USAF Phillips Laboratory, KAFB, NM; [3]Dept. of Physics, Lehigh Univ., Bethlehem, PA; [4]Sandia National Laboratories, Albuquerque, NM; [5]France Telecom/CNET, Meylan Cedex, France)

Session 4: Alternative Dielectrics

Thursday, Dec. 4, 1997

Session Chair: R. Wallace, Texas Instruments Inc., Dallas, TX

3:05 PM 4.1 **Detailed Characterization of Ta_2O_5 Thin Films Deposited on Silicon** C. Chaneliere[1], S. Four[2], J. L. Autran[1], R. A. B. Devine[2], and B. Balland[1] ([1]Laboratoire de Physique de la Matière (LPM), Villeurbanne, France; [2]France Telecom-CNET/CNS, Meylan, France)

3:25 PM 4.2 **Nitrogen-Engineering in Thermally Grown Ultrathin Silicon Oxynitrides** H. C. Lu[1], E. P. Gusev[2], E. Garfunkel[2], T. Gustafsson[1], M. L. Green[3], D. Brasen[3], and W. N. Lennard[4] (Departments of Physics[1] and Chemistry[2], and [1,2]Laboratory for Surface Modification, Rutgers Univ., NJ; [3]Bell Laboratories/Lucent Technologies, NJ; [4]Univ. of Western Ontario, Canada)

3:45 PM **Break**

4:15 PM 4.3 **Ultra-Thin Remote Plasma-Enhanced Chemical Vapor Deposited Oxide-Nitride Gate Dielectrics for MOSFETs** C. G. Parker[1], G. Lucovsky[1,2], and J. R. Hauser[1] ([1]Dept. of Electrical and Computer Engineering, NC State Univ., NC; [2]Dept. of Physics, NC State Univ.)

4:35 PM 4.4 **Enhanced Oxidation Rate of Oxynitrides During RTP Reoxidation in N_2O** Anthony I. Chou, Chuan Lin, Leith Zawadzki, Yongjoo Jeon, Aaron Lucas, and Jack C. Lee (Microelectronics Research Center, The Univ. of Texas at Austin, TX)

Poster Presentations II

Thursday, Dec. 4, 1997

Session Chair: G. Lucovsky, NC State University

4:55 PM P5.1 **Formation of Atomically Flat Si(100) Surface by H_2 Ambient Annealing and Its Preservation Through the Oxidation Process** Yoshinao Kumagai, Kenji Namba, Tadahiro Komeda, and Yasuhiro Nishioka (Texas Instruments, Tsukuba R & D Center Ltd., Tsukuba, Japan)

4:58 PM P5.2 **Evolution and Control of the Outer Si-SiO_2 Interface** C. Basa, Y. Z. Hu, and E. A. Irene (Dept. of Chemistry, Univ. of North Carolina at Chapel Hill)

5:01 PM P6.1 **Calculated Direct Tunneling Currents in Composite Oxide-Nitride Dielectrics: Comparison with Single Layer Oxides** Han-Yang Yang and Gerald

Lucovsky (Depts. of Electrical and Computer Engineering, Physics, and Materials Science and Engineering, NC State Univ., Raleigh, NC)

5:04 PM P6.2 **Tunneling Spectroscopic Studies of Metal-Oxide-Semiconductor Junctions** Whye-Kei Lye[1], Eiji Hasegawa[2], Tso-Ping Ma[1], and Richard C. Barker[1] ([1]Center for Microelectronic Materials and Structures, Dept. of Electrical Engineering, Yale Univ., New Haven, CT; [2]NEC Corporation, Japan), Yin Hu, John Kuehne, and David Frystak (Semiconductor Process and Device Center, Texas Instruments, Dallas, TX)

5:07 PM P7.1 **First Observation of the Bloembergen Effect in Thin Films on Silicon: A Probe of Local Electric Fields in Oxide Films** Milan Lillis[1], P. M. Lenahan[1], H. A. Kurtz[2], and S. P. Karna[3] ([1]The Pennsylvania State Univ., University Park, PA; [2]Dept. of Chemistry, Univ. of Memphis, TN; [3]USAF Phillips Lab, KAFB, NM)

5:10 PM P8.1 **Measurement of Breakdown Distributions in Silicon Oxides** J. C. Jackson, T. Robinson, O. Oralkan, D. J. Dumin (Clemson Univ., Clemson, SC), and G. A. Brown (Texas Instruments, Inc., Dallas, TX)

5:13 PM P8.2 **Structure Dependence of Uniform Electron Injection During Substrate Electron Injection** I. S. Al-Kofahi, S. Taylor, and K. Nutall (Dept. of Electrical Engineering, Liverpool Univ., Liverpool, UK)

5:16 PM P8.3 **Energy Levels of Electrons Trapped by Radiation-Induced Oxygen Vacancies in SiO_2** V. V. Afanas'ev and A. Stesmans (Dept. of Physics, Univ. Leuven, Belgium)

5:19 PM P8.4 **Study of Dielectric Breakdown on 4.3 nm Oxides Using Substrate Hot Electron Injection** T. Nigam, R. Degraeve, G. Groeseneken, and M. M. Heyns (IMEC, Leuven, Belgium)

5:22 PM P8.5 **Current Density Dependence of Trap Generation in the Gate Oxide of n-MOSFETs During Low Field Substrate Hot Electron Injection** I. S. Al-Kofahi[1], S. Taylor[2], and C. Beech[3] ([1]Hijjawi College of Appl. Engineering, Yarmouk Univ., Irbid, Jordan; [2]Dept. of Electrical Engineering, Liverpool Univ., Liverpool, UK; [3]GEC Plessy Semiconductors Ltd., Plymouth, England)

5:25 PM P8.6 **Study of the Time Dependence of Dose Rate Effects on Linear Bipolar IC's** R. K. Frietag and Dennis B. Brown (Naval Research Lab, Washington, DC)

Session 5: Physical Characterization of the Si-SiO_2 System

Friday, Dec. 5, 1997

Session Chairs: R. F. McFeely, IBM T. J. Watson Research Center

G. Lucovsky, NC State University

8:00 AM 5.1 ***Invited*** **Soft X-Ray Photoemission and Surface Infrared Studies of Model Silicon/Silicon Dioxide Interfaces: Does the Data Support A Fundamental Re-examination of How We Assign XPS Spectra of the Si/SiO_2 Interface?** Mark Banaszak Holl (Chemistry Dept., Univ. of Michigan, Ann Arbor, MI)

8:40 AM *5.2* ***Invited*** **Theoretical Study of Atomic Scale Processes at Si(001)-SiO_2 Interfaces** Mark Hybertson (Bell Labs, Lucent Technologies, Murray Hill, NJ)

9:20AM 5.3 **Post-Growth Annealing Effects of Ultrathin SiO_2 on Si(111): Interface States from Core-Level Photoemission** J. B. Rowe[1,3], H.-S. Tao[2], H. Niimi[3], H. Yang[3], T. B. Madey[2], and G. Lucovsky[3] ([1]Physics Division, Army Research Office, Research Triangle Park, NC; [2]Physics and Astronomy Dept. and Laboratory for Surface Modification, Rutgers Univ., NJ; [3]Dept. of Physics, Chemistry, and Materials Science, NC State Univ., Raleigh, NC)

9:40 AM 5.4 **Spectroscopic Ellipsometry, Neutron Reflectivity, and X-ray Reflectivity Characterization of SiO_2 on Si** C. A. Richter and J. A. Dura[1] (Semiconductor Electronics Division and [1]NIST-Center for Neutron Research, NIST, Gaithersburg, MD)

10:00 AM **Break**

10:30 AM 5.5 **Boron Diffusion in Silicon Oxides and Oxynitrides** K. A. Ellis and R. A. Buhrman (School of Applied and Engineering Physics, Cornell Univ., Ithaca, NY)

10:50AM 5.6 **Observation of Step Movement During Oxidation of the Si(111) Surface** Kenji Namba, Yoshinao Kumagai, Tadahiro Komeda, and Yasushiro Nishioka (Texas Instruments, Tsukuba R & D Center Ltd., Tsukuba, Japan)

Session 6: Tunneling Phenomena

Friday, Dec. 5, 1997

Session Chair: K. R. Farmer, NJIT

11:15 AM 6.1 ***Invited*** **Nanometer-Scale Studies of Oxide Charging and Hot-Electron Effects in MOS Structures Using Ballistic Electron Emission Microscopy** J. P. Pelz (Dept. of Physics, Ohio State Univ., OH)

11:55 AM 6.2 **Field-Dependent Studies of Transport and Breakdown in Locally Stressed SiO_2 Layers** H. J. Wen and R. Ludeke (IBM T. J. Watson Research Center, Yorktown Heights, NY)

12:15 PM 6.3 **Polarity Dependent Tunneling Current in Dual-Gate Ultra-Thin Oxides** Y. Shi and T. P. Ma (Dept. of Electrical Engineering, Yale Univ., New Haven, CT)

Session 7: Bulk and Interface Defects

Saturday, Dec. 6, 1997

Session Chair: W. Beall Fowler, Lehigh University

8:00 AM 7.1 ***Invited*** **EPR Studies of Interfaces and Volume Defects in Si/SiO_2 Structures with Ultrathin (<40 Å) Oxide Layers** H. J. von Bardeleben and J. L. Cantin (Groupe de Physique des Solides CNRS/Universites Paris, France)

8:40 AM 7.2 **Electron Spin Resonance Features of the P_{b1} Interface Defect in Thermal (100)Si/SiO_2** A. Stesmans and V. V. Afanas'ev (Dept. of Physics, Univ. of Leuven, Belgium)

9:00 AM 7.3 **The E_γ', E_δ', and Triplet-State Centers in Amorphous Silicon Dioxide: A First-Principles Quantum Chemical Study of Electronic Structure and Hyperfine Parameters** S. P. Karna, J. R. Chavez, R. D. Pugh, W. Shedd, C. P. Brothers, and B. K. Singaraju (USAF Phillips Laboratory, KAFB, NM)

9:20 AM 7.4 **Temperature Dependence of Generation and Relaxation Processes of Stress Induced Leakage Current in Ultra-Thin Oxides** P. Riess[1], A. Scarpa[2], G. Ghibaudo[1], G. Pananakakis[1], and J. Brini[1] ([1]Laboratoire de Physique de Composants à Semiconducteurs, ENSERG, Grenoble, France; [2]Dipartimento di Elettronica e Informatica, Universita di Padova, Italy)

9:40 AM 7.5 **Ultimate Limit for Defect Generation in Ultra-Thin SiO_2** D. J. DiMaria and J. H. Stathis, (IBM T. J. Watson Research Center, Yorktown Heights, NY)

10:00 AM **Break**

Session 8: Reliability

Saturday, Dec. 6, 1997

Session Chair: H. Maes, IMEC

10:30 AM 8.1 ***Invited* Flash Memory Technology and Reliability Issues Associated with SiO_2/Si Interfaces** Kuniyoshi Yoshikawa (Micro and Custom LSI Division, Toshiba Corporation, Kawasaki, Japan)

11:10AM 8.2 **Is the Constant Current Charge-to-Breakdown Test Still a Valid Tool to Study the Reliability of MOS Structures?** T. Nigam, R. Degraeve, G. Groeseneken, and M. Heyns (IMEC, Leuven, Belgium)

11:30 AM 8.3 **The Effect of Deuterium Passivation at Different Steps of CMOS Processing on Lifetime Improvements of CMOS Transistors** Jinju Lee[1], Yefim Epstein[2], Antonio Berti[2], John Huber[2], Karl Hess[1], and Joseph W. Lyding ([1]Beckman Institute for Advanced Science and Technology, Urbana, IL; [2]Digital Equipment Corp., Hudson, MA)

11:50 AM 8.4 **Hot Electron Reliability in Competing 80 nm Dual-Gate SOI n-MOSFETs** S. C. Williams, W. C. Holton, M. A. Littlejohn, and K. W. Kim (Dept. of Electrical and Computer Engineering, NC State Univ., NC)

12:10 PM **Closing Remarks**