



**31<sup>st</sup> IEEE  
Semiconductor Interface  
Specialists Conference**

December 7-9, 2000  
Catamaran Resort, San Diego, CA



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**ABSTRACTS**

**General Chair: Beall Fowler**

**Technical Chair: Kathy Krisch**

**Arrangements Chair: Lori Lipkin**

**Past Conference Chair: Dan Fleetwood**

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**SISC Ed Nicollian Award for Best Student Paper**

In 1995 the SISC began presenting an award to the best student presentation of the SISC in honor of Professor E. H. Nicollian, University of North Carolina at Charlotte. Professor Nicollian was a pioneer in the exploration of the metal-oxide-semiconductor system, particularly in the area of electrical measurements. His efforts were fundamental to establishing the SISC in its early years, and he served as its technical program chair in 1982. With John Brews, he wrote the definitive book, "MOS Physics and Technology," published by Wiley Interscience.

The *SISC Ed Nicollian Award for Best Student Paper* is presented to the lead student author of either an oral or poster presentation. The winner is chosen at the end of the SISC by members of the technical program committee. The award consists of a plaque and an honorarium sent to the winner after the Conference. To honor the winner, the award is announced at the conference taking place the following year.

The *1999 SISC Ed Nicollian Award for Best Student Paper* was given to **Shigeyasu Uno** of Osaka University. The paper was entitled "I-V Characteristics of Ultra Thin Oxide Films after Soft Breakdown." Co-authors are T. Sakura, Y. Kamakura, and K. Taniguchi.

Those eligible and wishing to be considered for the 2000 SISC Ed Nicollian Award for Best Student Paper should contact the 2000 IEEE SISC Technical Chair before Friday, December 8, 2000.



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**Session 1 – High-K Gate Dielectrics - I**

Thursday, December 7, 2000

Session Chair: W. Beall Fowler (Lehigh University) and E. Gusev (IBM)

- 8:00 AM **Welcome and Opening Remarks**
- 8:10 AM 1.1 *Invited* – **N- and P-Channel FETs Built with HfO<sub>2</sub> and ZrO<sub>2</sub>**, S.A. Campbell, N. Hoilien, R. Smith, T.Z. Ma, W.L. Gladfelter (University of Minnesota)
- 8:50 AM 1.2 - **Electrical Properties of Ultra-Thin Hafnium Oxide Gate Dielectrics**, W. Zhu, T. Tamagawa\*, B. Halpern\*, X.W. Wang, T.P. Ma (Yale University, \*Jet Process Corp)
- 9:10 AM 1.3 - **Characterization of RuO<sub>2</sub> Electrodes on ZrSiO<sub>4</sub> and ZrO<sub>2</sub> Dielectrics for Si-PMOSFETs**, H. Zhong, G. Heuss, V. Misra (North Carolina State University)
- 9:30 AM 1.4 - **A Microscopic Model for Enhanced Dielectric Constants in low Zr Concentration SiO<sub>2</sub>-Rich Non-Crystalline Zr and Hf Silicate Alloys**, G. Lucovsky and B. Rayner (North Carolina State University)
- 9:50 AM **Discussion**
- 10:00 AM **BREAK**

**Session 2 – Devices and Non-Volatile Memory**

Thursday, December 7, 2000

Session Chair: B.-Y. Nguyen. (Motorola)

- 10:30 AM 2.1 - **Anomalous Leakage Current Observed in Floating Gate Nonvolatile Memories**, B. Hornung, P. Kuhn, T. Harp, R. Paulsen, S. Morris, J. Bridwell (Motorola)
- 10:50 AM 2.2 - **Electrical Characterization of ONO Ultra-Thin Gate Dielectric in SONOS NVSM**, J. Bu, W. Welch, and M. White (Lehigh University)
- 11:10 AM 2.3 **Hot-Carrier Performance of 60-nm Channel Length Delta-Doped Vertical MOSFETs with High-Pressure Grown Oxide as a Gate Dielectric**, V. Ramgopal Rao, S. Mahapatra, J. Vasi, K. Anil\*, C. Fink\*, W. Hansch\* and I. Eisele\* (Indian Institute of Technology – Bombay, \*Universitat der Bundeswehr Munchen)
- 11:30 AM **Discussion**

## Session 3 - Posters I

Thursday, December 7, 2000

Session Chair: M.J. Uren (DERA)

- 11:40 AM **P3.1 – Physical and Electrical Characterization of Hafnium Oxide and Hafnium Silicate Sputtered Films**, A. Callegari, E. Cartier, M. Gribelyuk\*, H.F. Okorn-Schmidt and T. Zabel (IBM Research, \*IBM Microelectronics)
- 11:43 AM **P3.2 – Thermal Stability and Interface Limitations for Integration of Non-Crystalline Al<sub>2</sub>O<sub>3</sub> as a Gate Dielectric in Advanced Si CMOS Devices**, R. Johnson, J. G. Hong, G. Lucovsky (North Carolina State University)
- 11:46 AM **P3.3 – Zr Diffusion Measurements into Si from Zr-based Gate Dielectrics**, M. Quevedo-Lopez, M. El-Bouanani, B. Gnade, R. Wallace, L. Colombo\*, M. Bevan\*, M. Douglas\*, H.-Y. Lu\*, D. Mercer\*, A. Rotondaro\* (University of North Texas, \*Texas Instruments)
- 11:49 AM **P3.4 – Fundamental Limitations on Device Performance in Si MOS Devices with High-K Gate Dielectrics: The Problem, Heterovalent Interfaces, and a Proposed Solution, Aluminate Alloys with Isovalent Interfaces**, G. Lucovsky, H. Niimi, R. Therrien, R. Johnson, B. Rayner, J. G. Hong (North Carolina State University)
- 11:52 AM **P3.5 – Mechanism for Retention Degradation under Over-Erase in SONOS NVSM**, J. Bu and M. White (Lehigh University).
- 11:55 AM **P3.6 – Interface-Trap Generation Near the Edges of MOSFETs under Various Stress Conditions**, A. Melik-Martirosian and T.P. Ma (Yale University)
- 11:58 AM **P3.7 – A New Observation of Plasma-Induced Damage in Surface Channel P-MOSFETs by the Charging-Pumping Profiling Technique**, S.S. Chung, S.J. Chen, C.-C. Lin, Y.-J. Chang\*, H.-S. Fang\* (National Chiao Tung University, \*ITRI-Taiwan)
- 12:01 PM **P3.8 – Effects of Alternating Bias Irradiation on Defects in MOS Devices**, J. Felix, D. Fleetwood, L. Riewe\*, P. Winokur \* (Vanderbilt University, \*Sandia National Laboratories)
- 12:04 PM **Adjourn**

## Session 4 – Hydrogen and Surface Chemistry

Thursday, December 7, 2000

Session Chair: Y. Ma (Lucent Technologies)

- 1:30 PM 4.1 - **A New Infrared and Density Functional Theory Study of Spherosiloxane-Based Model Silicon/Silicon Oxide Interfaces**, K. Nicholson and M Banaszak Holl, (University of Michigan)
- 1:50 PM 4.2 - **The Influence of Near-Interface H<sup>+</sup> Traps on H<sup>+</sup> Transport in Hydrogenated Unibond Buried Oxides**, P. Macfarlane and R. Stahlbush (Naval Research Laboratory)
- 2:10 PM 4.3 - **Reactions of Hydrogen with Si-SiO<sub>2</sub> Interfaces**, S. Rashkeev\*, R. Buczko\*<sup>#</sup>, D. Fleetwood\*, R. Schrimpf\*, S. Pantelides\*<sup>#</sup> (\*Vanderbilt University, <sup>#</sup>Oak Ridge National Laboratory)
- 2:30 PM 4.4 – **Atomistic Embedding Method for Defects in a-SiO<sub>2</sub>: Applications to H in SiO<sub>2</sub> and to Models for Border Traps**, P. Sushko, A. Shluger, A. Edwards\*, W. Shedd\*, R. Pugh\* (Univeristy College of London, \*Air Force Research Laboratory)
- 2:50 PM **Discussion**

## Session 5 - Posters II

Thursday, December 7, 2000

Session Chairs: E. Vogel (NIST) and K. Okada (Matsushita)

- 3:00 PM P5.1 – **Examination of the Si(111)-SiO<sub>2</sub>, Si(110)-SiO<sub>2</sub> and Si(100)-SiO<sub>2</sub> Interfacial Properties Following Rapid Thermal Annealing**, P. Hurley, B. O'Sullivan, F. Cubaynes\*, P. Stolk\*, F. Widdershoven\*, J. Das<sup>#</sup> (NMRC, \*Phillips Research Laboratories, <sup>#</sup>STEAG RTP Systems)
- 3:03 PM P5.2 – **Enhanced Deuterium Incorporation at the Oxide/Silicon Interface**, K. Cheng, J. Lee, J. Lyding (University of Illinois at Urbana-Champaign)
- 3:06 PM P5.3 – **Dissociation of Hydrogen Atoms Terminating Si(100)/SiO<sub>2</sub> Interface Defects**, C. Kaneta, T. Yamasaki, T. Uda\* (Fujitsu Laboratories, \*JRCST-ATP)
- 3:09 PM P5.4 – **Generation and Anneal Mechanisms of E' Centers in a-SiO<sub>2</sub>**, A. Pineda, S. Karna\*, R. Pugh\*, W. Shedd\*, T. Oldham<sup>#</sup> (University of New Mexico, \*Air Force Research Laboratory, <sup>#</sup>Army Research Laboratory)
- 3:12 PM P5.5 – **Charged and Neutral Oxidising Species in Amorphous Silicon Dioxide: Role of Charging in Silicon Oxidation from Ab-Initio Calculations**, M. Szymanski, A. Stoneham, A. Shluger (University College London)
- 3:15 PM P5.6 – **Validity of the Bond-Energy Picture for the Energetics at Si-SiO<sub>2</sub> Interfaces**, A. Bongiorno and A. Pasquarello (Ecole Polytechnique Federale de Lausanne)
- 3:18 PM P5.7 – **Scanning Tunneling Microscopy and Spectroscopy Study of a Model Si/SiO<sub>2</sub> Interface: Spherosiloxane Clusters on Si(100)**, K. Schneider, Z. Zhang, B. Orr, M. Banaszak Holl (University of Michigan)

3:21 PM **BREAK**

## **Session 6 –Dielectrics on Wide-Bandgap Semiconductors**

Thursday, December 7, 2000

Session Chair: C.-M. Zetterling (KTH)

- 3:50 PM 6.1 *Invited* - **High Power Devices in Silicon and Silicon Carbide**, H. Lendenmann, F. Dahlquist and P. Skytt (ABB Research)
- 4:30 PM 6.2 - **Light Emission from Interface Traps and Bulk Defects in SiC MOSFETs**, R. Stahlbush and P. Macfarlane (Naval Research Laboratory)
- 4:50 PM 6.3 - **GaN MIS Capacitors with High-Quality ONO Dielectric Stack**, X.-W. Wang, T.P. Ma, B. Gaffey, L. Guido (Yale University)
- 5:10 PM **Discussion**

## **Session 7 - Posters III**

Thursday, December 7, 2000

Session Chairs: X.W. Wang (Yale University) and G. Ghibaudo (LPCS/ENSERG)

- 5:20 PM P7.1 – **Electrical Characteristics of Al<sub>2</sub>O<sub>3</sub> on SiC MOS Devices**, H. Lazar and V. Misra (North Carolina State University)
- 5:23 PM P7.2 – **Hole Photoemission from Hexagonal SiC Polytypes into SiO<sub>2</sub>**, V. Afanas'ev and A. Stesmans (University of Leuven)
- 5:26 PM P7.3 – **Accumulation-Layer Electron Mobility in n-Channel 4H-SiC MOSFETs**, K. Chatty, T.P. Chow, R.J. Gutmann, E. Arnold\*, D. Alok\* (Rensselaer Polytechnic Institute, \*Philips Research)
- 5:29 PM P7.4 – **On C-V Measurement and Quantum Tunneling in MOS Structures with Ultra-Thin Oxides (1.4 - 3nm)**, R. Clerc, A. Spinelli\*, G. Ghibaudo, C. Leroux<sup>#</sup>, G. Pananakakis (LPCS/IPG/CNRS-Grenoble, \*University of Milano, <sup>#</sup>CEA/LETI-Grenoble)
- 5:32 PM P7.5 – **Temperature Dependence of Current Noise Fluctuation of Soft Breakdown in Ultra-Thin Oxides**, A. Cester, A. Paccagnella, G. Ghidini\*, I. Bloom<sup>#</sup> (University of Padova, \*ST Microelectronics, <sup>#</sup>Saifun Semiconductors)
- 5:35 PM P7.6 – **Inelastic Electron Tunneling Spectroscopy Study of Ultra-Thin Dielectrics**, W. He, T.P. Ma, R. Barker, W.-K. Lye\* (Yale University, \*University of Virginia)
- 5:38 PM P7.7 – **Reactive and Non-Reactive Hydrogen Species in the Gate SiO<sub>2</sub>**, C.Z. Zhao, J.F. Zhang, G. Groeseneken\*, R. Degraeve\*, J.N. Ellis<sup>#</sup>, C.D. Beech<sup>#</sup> (Liverpool John Moores University, \*IMEC, <sup>#</sup>Mitel Semiconductor)
- 5:41 PM **Adjourn**
- Evening **Poster Reception**

## Session 8 – Breakdown I

Friday, December 8, 2000

Session Chair: R. Degraeve (IMEC)

- 8:00 AM 8.1 *Invited* – **Theory of Oxide Breakdown**, M. A. Alam, B.E. Weir, J.D. Bude, and P.J. Silverman (Bell Laboratories, Lucent Technologies)
- 8:30 AM 8.2 *Invited* – **Carrier Transport in Stressed Thin Gate Oxides** – S. Takagi (Toshiba)
- 9:00 AM 8.3 *Invited* – **Quasi-Breakdown vs. Hard Breakdown in Ultrathin SiO<sub>2</sub> Films: Beyond the Appearances**, E. Vincent, S. Bruyere, D. Roy, F. Monsieur (ST Microelectronics)
- 9:30 AM **Panel Discussion and Questions on Papers 5.1 – 5.3**
- 10:00 AM **BREAK**

## Session 9 – Breakdown II

Friday, December 8, 2000

Session Chair: E. Cartier (IBM)

- 10:30 AM 9.1 - **Degradation and Breakdown of Ultra-Thin Silicon Dioxide Induced by Substrate Hot-Hole Injection**, E. Vogel and J. Suehle (National Institute of Standards and Technology)
- 10:50 AM 9.2 - **Defect Generation in Thin SiO<sub>2</sub> from Anode Hole Injection**, D.J. DiMaria (IBM Research)
- 11:10 AM 9.3 - **Temperature Dependence of Time-to-Breakdown in 2.5nm Nitrided Oxides**, R. Degraeve, G. Groeseneken, T. Conrad, M. Schaekers (IMEC)
- 11:30 AM 9.4 - **Radiation-Induced Soft Breakdown in Thin Gate Oxides**, M. Ceschia, A. Paccagnella, G. Ghidini\*, J. Wyss (University of Padova, \*ST Microelectronics)
- 11:50 AM 9.5 - **Increase of the Critical Defect Density for SiO<sub>2</sub> Breakdown for Very Long Duration Stress Experiments**, J. Stathis, A. Vayshenker\*, P. Varekamp\*, P. Smeys\* (IBM Research, \*IBM Microelectronics)
- 12:10 PM **Discussion**
- 12:20 PM **Adjourn**

## Optional “Rump Sessions”

Friday, December 8, 2000

- 2:00-4:00 PM **Tentative Topics:**  
#1: High-K Dielectrics  
#2: SiC  
#3: Reliability

Evening **Conference Banquet and Limerick Contest**



## Session 10 – High-K Gate Dielectrics - II

Saturday, December 9, 2000

Session Chair: R. Wallace (University of North Texas)

- 8:00 AM 10.1 *Invited* - **Characterization of Ultrathin Films of Metal Oxides for CMOS Applications**, D.A. Buchanan (IBM Research)
- 8:40 AM 10.2 - **Electron Spin Resonance Observation of Si Dangling Bond Type Defects at the Interface of (100)Si and Ultrathin Stacks of SiO<sub>2</sub>, Al<sub>2</sub>O<sub>3</sub> and ZrO<sub>2</sub>**, A. Stesmans, V.V. Afanas'ev and M. Houssa (University of Leuven)
- 9:00 AM 10.3 – **Interface and Dielectric Characteristics of Ultra-Thin Si-Doped Zirconium Aluminate**, J.P. Han, L. Manchanda, M.L. Green, R.B. van Dover, M.D. Morris, A. Kerber, Y. Hu, P.J. Silverman, T.W. Sorsch, G. Weber, V. Donnelly, K. Pelhos, F. Klemens, N.A. Ciampia, B. Busch\*, and H. Schulte\*, (Bell Labs - Lucent Technologies, \*Rutgers University)
- 9:20 AM 10.4 – **Characterization of Ultra-thin (~1nm) Zr Silicate for CMOS Gate Application**, Z.J. Luo, T.P. Ma, E. Cartier\*, M. Copel\*, T. Tamagawa<sup>#</sup>, B. Halpern<sup>#</sup> (Yale University, \*IBM Research, <sup>#</sup>Jet Process Corporation)
- 9:40 **Discussion**
- 9:50 **BREAK**

## Session 11 – High K Gate Dielectrics - III

Saturday, December 9, 2000

Y. Nishioka (Texas Instruments)

- 10:20 AM 11.1 *Invited* - **Atomic Layer Deposition of Ultrathin Films using Sequential Surface Reactions**, S. George (University of Colorado)
- 11:00 AM 11.2 - **Accurate Detection of Changes in Interface Composition for High-K Dielectrics on Si**, B. Busch, W. Schulte, S. Sayan, E. Garfunkel, T. Gustafsson (Rutgers University)
- 11:20 AM 11.3 - **Lanthanum and Hafnium-Containing Silica Alloys: A Critical Materials Evaluation**, J.-P. Maria, D. Wicaksana, J. Parrette, A.I. Kingon, H. Schmit\*, B. Busch\*, and E. Garfunkel\* (North Carolina State University, \*Rutgers University)
- 11:40 AM 11.4 - **Ultrathin HfO<sub>2</sub> Films Grown by Atomic Layer Chemical Vapor Deposition (ALCVD) for Advanced Gate Dielectric Applications**, E.P. Gusev, E. Cartier, M. Copel, M. Gribelyuk<sup>#</sup>, D.A. Buchanan, M. Tuominen\*, M. Jussila\*, S. Haukka\* (<sup>1</sup>IBM Research, <sup>#</sup>IBM Microelectronics, \*ASM Microchemistry)
- 12:00 PM **Discussion**
- 12:10 PM **Closing Remarks**