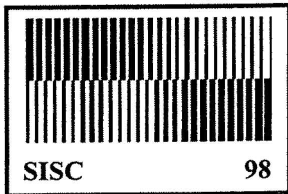

29th IEEE Semiconductor Interface Specialists Conference

December 3 – 5, 1998
Catamaran Resort Hotel, San Diego, California

ABSTRACTS

General Chair: Len Trombetta

Technical Chair: Dan Fleetwood

Arrangements Chair: W. Beall Fowler

Past Conference Chair: Doug Buchanan

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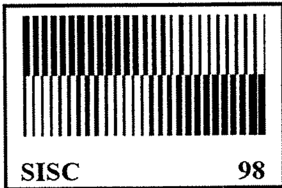

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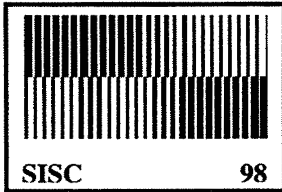

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Session 1: Nonvolatile Memories and Hydrogen Effects

Thursday, Dec. 3, 1998
Session Chair: Len Trombetta (University of Houston)

8:00 AM **WELCOME & OPENING REMARKS**

8:10 AM 1.1 *Plenary Talk* **The Embedded Flash – The Last Frontier for Semiconductor Device Physicists** Yoav Nissan-Cohen (Co-CEO, Tower Semiconductor, Israel)

9:00 AM 1.2 **Direct Tunneling Diode Structure with a Multi-Layer Charge Injection Barrier** E. M. Dons, C. S. Skowronski, and K. R. Farmer (New Jersey Institute of Technology)

9:20 AM 1.3 **Hydrogen Diffusion and Chemistry During the Annealing-Induced Generation of Mobile Protons in the Oxide Layer of Si/SiO_2/Si Capacitors** K. Vanheusden (US Air Force Research Laboratory), R. A. B. Devine (France Telecom/CNET), D. M. Fleetwood, and W. L. Warren (Sandia National Laboratories)

9:40 AM 1.4 **The Effects of Process-Induced and Radiation-Induced Defects on H+ Transport in SiO_2** R. E. Stahlbush, H. L. Hughes (Naval Research Laboratory), and R. K. Lawrence (ARACOR)

10:00 AM **BREAK**

Session 2: Surface Chemistry/Interface Defects

Thursday, Dec. 3, 1998
Session Chair: Mary Ellen Zvanut (Univ. of Alabama-Birmingham)

10:20 AM 2.1 *Invited* **Understanding the Evolution of Silicon Surface Morphology During Aqueous Etching** Melissa Hines (Cornell University)

11:00 AM 2.2 **Detection of P_b Centers by Spin-Dependent Charge Pumping** J. H. Stathis (IBM TJ Watson Research Center) and H. Nishikawa (Tokyo Metropolitan University)

11:20 AM 2.3 **The Identity of the P_{b1} Interface Defect in Thermal (100) Si/SiO_2: ^{29}Si Hyperfine Structure Observed by Electron Spin Resonance**
A. Stesmans and V. V. Afanas'ev (University of Leuven)

Poster Session I: Hydrogen and Defects

Thursday, Dec. 3, 1998

Session Co-Chairs: Karel Vanheusden (US Air Force Research Laboratory)
Akira Toriumi (Toshiba)

11:40 AM PI.1 **Temperature Dependence of Deuterium Isotope Effect in Dominant Mechanisms of Hot Carrier Degradation** J. Lee, Z. Chen, E. Foley, K. Cheng, K. Hess, J. W. Lyding (Beckman Institute, University of Illinois), S. Lee, K. Huh, S. Lee, J. Park, and Y. Lee (LG-Semicon Co., Ltd.)

11:43 AM PI.2 **Examination of Deuterium Transport Through CMOS Device Structures** P. J. Chen and R. M. Wallace (Texas Instruments)

11:46 AM PI.3 **Theory of Electron Capture by Protons in a-SiO_2 and at the Si-SiO_2 Interface** A. H. Edwards (UNC-Charlotte), S. P. Karna, J. Chavez, C. P. Brothers, R. D. Pugh, W. M. Shedd, B. K. Singaraju (US Air Force Research Laboratory), M. Vitiello, G. Pacchioni (Universita' degli Studi di Milano), and W. B. Fowler (Lehigh University)

11:49 AM PI.4 **Hydrogen Reaction at Silicon Dangling Bonds** H. A. Kurtz (University of Memphis), B. Kirtman (University of California – Santa Barbara), and S. P. Karna (US Air Force Research Laboratory)

11:52 AM PI.5 **Electron Paramagnetic Resonance Study of Interface Defects in NO Treated (100) Si/SiO_2** H. J. von Bardeleben, J. L. Cantin, L. G. Gosset, J. J. Ganem, I. Trimaille, and S. Rigo (Universités Paris 6&7)

11:55 AM PI.6 **A Preliminary Study of the Kinetics of E'-Precursor Formation During Post-Oxidation Rapid Thermal Anneals** J. F. Conley, Jr. and W. F. McArthur (Dynamics Research Corporation), and P. M. Lenahan (Penn St. University)

11:58 AM PI.7 **Electronic Structure Studies of the Atomic Configuration of E'_δ Center in *a*-SiO_2** S. P. Karna, R. D. Pugh, W. Shedd, B. K. Singaraju (US Air Force Research Laboratory), and A. C. Pineda (University of New Mexico)

12:01 PM PI.8 **Defects in Thermal Oxides Studied by Photoluminescence Spectroscopy** H. Nishikawa (Tokyo Metropolitan University), J. H. Stathis, and E. Cartier (IBM TJ Watson Research Center)

12:04 PM **LUNCH**

Session 3: Radiation Effects

Thursday, Dec. 3, 1998
Session Chair: Dennis Brown (Naval Research Laboratory)

1:45 PM — 3.1 *Invited* **Basic Mechanisms of Radiation Damage in Semiconductor Devices – Revisited with an Eye Towards the Future**
Paul Dressendorfer (Sandia National Laboratories)

2:25 PM — 3.2 **Correlation of Positive Charge Trapping in SiO_2 with Oxide Density**
B. J. Mrstik (Naval Research Laboratory), V. V. Afanas'ev, A. Stesmans (University of Leuven), and P. J. McMarr (NRL/SFA)

2:45 PM — 3.3 **Stability of Trapped Electrons in SiO_2** D. M. Fleetwood, P. S. Winokur (Sandia National Laboratories), O. Flament, and J. L. Leray (CEA, France)

Poster Session II: Thin Oxides

Thursday, Dec. 3, 1998
Session Chair: Mike Uren (DERA)

3:05 PM — PII.1 **Influence of Boron Diffusion on Reliability of Ultrathin Oxides**
T. Nigam, R. Degraeve, and M. M. Heyns (IMEC)

3:08 PM — PII.2 **Effect of Boron Penetration on Stress Induced Leakage Current and Breakdown in P+ Gate MOS Structures** C. Jahan, K. Barla (Centre Commun CNET ST), and G. Ghibaudo (LPCS/ENSERG)

3:11 PM — PII.3 **DC-SILC in p^+ Poly MOS Capacitors with Poly-Si and Poly-$Si_{0.7}Ge_{0.3}$ Gate Material** V. E. Houtsma, A. J. Hof, J. Holleman, C. Salm (University of Twente), F. P. Widdershoven (Philips Research Laboratories), P. H. Woerlee (Philips Research Laboratories/U. Twente)

3:14 PM — PII.4 **MOSFET Substrate Currents due to Valence-Band Tunneling in 15 to 35 Å-Thick Gate Dielectrics** A. Shanware, H. Z. Massoud (Duke University), E. Vogel, K. Henson, J. R. Hauser, and J. J. Wortman (North Carolina St. University)

3:17 PM — PII.5 **Direct Observation of Trap Assisted Tunneling in Stress Damaged Ultra-Thin Oxides** W. K. Lye, T. P. Ma, R. C. Barker (Yale University), E. Hasegawa (NEC), Y. Hu, J. Kuehne, and D. Frystak (Texas Instruments)

3:20 PM — PII.6 **Modeling of Soft Breakdown I-V Characteristic in < 5 nm Gate Oxides**
E. Miranda, J. Suñé, R. Rodríguez, M. Nafría, and X. Aymerich (Universitat Autònoma de Barcelona)

3:23 PM — PII.7 **Dit-Distribution Difference Between Pre- and Post-FN Electron Injection into Thin Gate Oxide** Y. Mitani, H. Satake, and A. Toriumi (Toshiba Corp.)

3:26 PM — PII.8 **A Unified Hot Carrier Reliability Monitor for Two-Generations of Submicron and Deep-Submicron n-MOSFETs** S. S. Chung, S. J. Chen, C. M. Yih, S. T. Liaw (National Chiao Tung University), and M. S. Liang (TSMC)

3:30 PM — **BREAK**

Session 4: SOI/Oxide Defects

Thursday, Dec. 3, 1998

Session Chair: Robert Wallace (Texas Instruments)

3:50 PM 4.1 *Invited* **SOI Materials and Gate Oxide Reliability** Devendra Sadana, R. Bolam, F. Assaderaghi, G. Shahidi, and D. Badana (IBM)

4:30 PM 4.2 **Silicon Epoxides in MOS Oxides?** W. Beall Fowler (Lehigh University) and A. H. Edwards (UNC – Charlotte)

4:50 PM 4.3 **Bonding Constraint-Induced Defect Formation at Si-Dielectric Interfaces** G. Lucovsky, Y. Wu, H. Niimi, and V. Misra (North Carolina St. University)

Poster Session III: Dielectrics and SiC

Thursday, Dec. 3, 1998

Session Chair: Gerry Lucovsky (North Carolina State University)

5:10 PM PIII.1 **Reliability of Metal/$SrBi_2Ta_2O_9$/SiN/Si Ferroelectric Memory Capacitor** J. Han, X. Guo, and T. P. Ma (Yale University)

5:13 PM PIII.2 **Comparative Study of TiO_2 and Ta_2O_5 on JVD Barrier Nitride as High-K Stacked Gate Dielectrics** B. H. Lee, Y. Jeon, A. Lucas, J. C. Lee (University of Texas), M. Gardner (Advanced Micro Devices), M. C. Gilmer (SEMATECH), and J. Fair (Novellus)

5:16 PM PIII.3 **Hot Carrier Currents in Field Effect Transistors with Silicon Nitride as Gate Dielectric** M. Khare, T. P. Ma (Yale U.), H. H. Tseng, P. J. Tobin (Motorola)

5:19 PM PIII.4 **Microscopic Model for Boron-Atom Penetration Through Silicon Dioxide and Suppression of Boron Transport Through Silicon Nitride** Y. Wu, H. Niimi, H. Yang, G. Lucovsky (North Carolina St. U.), and R. Fair (Duke Univ.)

5:22 PM PIII.5 **Mechanisms of Thermal Oxynitridation of SiO_2 in Nitric Oxide** J. J. Ganem, L. G. Gosset, I. Trimaille, S. Riga (Universités Paris 6&7), and I. J. R. Baumvol (Instituto de Fisica – UFRGS)

5:25 PM PIII.6 **Plasma Oxidation of SiGe Heterostructures: Recent Electrical Results** L. S. Riley and S. Hall (University of Liverpool)

5:28 PM PIII.7 **Reliability Assessment of Wet and Dry Oxides on N-Type 4H SiC** C. J. Anthony, A. Jones, and M. J. Uren (Defence Evaluation and Research Agency, UK)

5:31 PM PIII.8 **Hydrogen-Induced Positive Charging of Thermal Oxide/SiC Interfaces** V. V. Afanas'ev and A. Stesmans (University of Leuven)

7-10 PM **POSTER RECEPTION**

Session 5: Thin Oxides

Friday, Dec. 4, 1998

Session Co-Chairs: Kathy Krisch (Bell Labs – Lucent Technologies)
Doug Buchanan (IBM TJ Watson Research Center)

8:00 AM 5.1 *Invited* **Electrical Characterization of Ultrathin Oxides**
K. R. Farmer (New Jersey Institute of Technology)

8:40 AM 5.2 **A New Physically-Based Model for Temperature Acceleration of Time-to-Breakdown** N. Pangon, R. Degraeve, Ph. Roussel, G. Groeseneken, and H. E. Maes (IMEC)

9:00 AM 5.3 **An Inelastic Quantum Tunneling Model for Current Conduction After Soft-Breakdown** T. Nigam, R. Degraeve, M. Heyns, G. Groeseneken, H. E. Maes (IMEC), and F. Crupi (University of Pisa)

9:20 AM 5.4 **Understanding the Conduction Properties of a Breakdown Spot in Thin-Oxide MOS Capacitors** J. Suñé, E. Miranda, M. Nafría, and X. Aymerich (Universitat Autònoma de Barcelona)

9:40AM 5.5 **Investigation of SiO_2 Breakdown at Small Areas Using an Atomic Force Microscope Tip** D. Abusch-Magder, D. Monroe, R. N. Kleiman, F. Capasso, M. Green, P. J. Silverman, and B. E. Weir (Bell Labs – Lucent Technologies)

10:00 AM 5.6 **Mechanisms of Heavy-Ion Induced Gate Rupture in Thin Oxides**
F. W. Sexton, D. M. Fleetwood (Sandia National Laboratories), and K. S. Krisch (Bell Labs – Lucent Technologies)

10:20 AM **BREAK**

Session 6: Nitrides and Oxynitrides

Friday, Dec. 4, 1998

Session Co-Chairs: Robert Buhrman (Cornell University)
Taishi Kubota (NEC Corporation)

10:45 AM 6.1 *Invited* **Characterization and Control of Ultrathin Oxide Interfaces** Yasu Nishioka, K. Namba, M. Matsumura, T. Sakoda, Y. Kumagai, T. Komeda (Texas Instruments, Japan), H. Kobayashi (Osaka University), T. Hoshino (Chiba University), A. Ando, and K. Miki (ETL, Tsukuba, Japan)

11:25 AM 6.2 **Physical Properties of Thin JVD Nitride Gate Dielectrics** K. S. Krisch, M. Weldon, F. Baumann, J. Bude, J. P. Chang, R. Opila, A. DeSanto, M. Mandich, P. J. Silverman (Bell Labs – Lucent), M. Khare, X. W. Wang, and T. P. Ma (Yale U.)

11:45 AM 6.3 **Dopant Diffusion in Silicon Oxides and Oxynitrides**
K. A. Ellis and R. A. Buhrman (Cornell University)

12:05 PM 6.4 **Interfacial Properties of Ultra-Thin Pure Silicon Nitride Formed by Remote Plasma Enhanced CVD** V. Misra, Z. Wang, Y. Wu, H. Niimi, G. Lucovsky, J. J. Wortman, and J. R. Hauser (North Carolina State University)

Session 7: Silicon Carbide

Saturday, Dec. 5, 1998

Session Chair: Lori Lipkin (Cree Research)

8:00 AM 7.1 *Invited* **Dielectric Issues for Silicon Carbide MOS Devices** Carl-Mikael Zetterling (KTH, Royal Institute of Technology)

8:40 AM 7.2 **Observation of a Si P_b-Like Center in Heat-Treated Oxidized 3C-SiC** P. J. Macfarlane and M. E. Zvanut (University of Alabama-Birmingham)

9:00 AM 7.3 **Inversion Channel Mobility in 4H- and 6H-SiC MOSFETs** M. K. Das, J. A. Cooper, Jr., M. R. Melloch, and M. A. Capano (Purdue University)

9:20 AM 7.4 **Characterization of Electron Mobility in 6H-SiC MOSFETs** N. S. Saks (Naval Research Lab), A. K. Agarwal, and S. S. Mani (Northrop Grumman Corp.)

9:40 AM 7.5 **High-Temperature Characteristics of High-Quality SiC MIS Capacitors with Oxide/Nitride/Oxide Gate Dielectric** X. W. Wang, Z. J. Luo, T. P. Ma (Yale Univ.), G. J. Cui, T. Tamagawa, and B. Halpern (Jet Process Corporation)

10:00 AM **BREAK**

Session 8: Alternative Dielectrics

Saturday, Dec. 5, 1998

Session Chair: Matthias Passlack (Motorola)

10:30 AM* 8.1 *Invited* **MOSFET Tunneling Issues in SiO_2 and Alternative Dielectrics – Challenges and Opportunities** H. Z. Massoud, J. P. Shiley, and A. Shanware (Duke University)

11:10 AM 8.2 **Structure and Interface Stability of Ultrathin Films of High Dielectric Constant Materials on Silicon** H. C. Lu, E. Gusev, E. Garfunkel, T. Gustaffson (Rutgers Univ.), G. Alers (Bell Labs – Lucent Technol.), and N. Yasuda (Toshiba)

11:30 AM 8.3 **Gate Current and Reliability of Ultrathin (~2.0 nm) TiO_2/Si_3N_4 Stack Gate Dielectric** X. Guo and T. P. Ma (Yale University)

11:50 AM 8.4 **Crystalline Oxides-on-Silicon – Alternative Gate Oxide Dielectrics** R. A. McKee, F. J. Walker, and M. F. Chisholm (Oak Ridge National Laboratory)

12:10 PM **CLOSING REMARKS**

*Withdrawn **Effects of the Electrode Interface on the Dielectric Performance of Barium Strontium Titanate Capacitors** Brad Melnick, P. Chu, B. White, S. Zafar, M. Kottke, W. Chen, P. Fejes, P. Zurcher, C. Tracy, and B. Jones (Motorola)