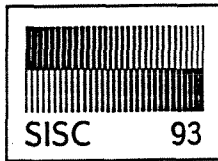


24th IEEE  
**SEMICONDUCTOR INTERFACE  
SPECIALISTS CONFERENCE**  
Dec 9-11, 1993, Fort Lauderdale, Florida

## **ABSTRACTS**

<b>General Chair:</b>	<b>L. Manchanda</b>
<b>Technical Chair:</b>	<b>H. Z. Massoud</b>
<b>Arrangements Chair:</b>	<b>W. L. Warren</b>

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# 24th IEEE SISC 93



**Fort Lauderdale, Florida**

**Dec 8-11, 1993**

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101 Crawfords Corner Road, Room 4C-406  
Holmdel, NJ 07733

H. Z. Massoud  
*Program Chair*

Department of Electrical Engineering  
Duke University, Box 90291  
Durham, NC 27708-0291

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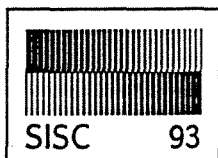
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## SESSION 1 - PLENARY

Thursday 12/9/93, 8:30 am - 12:00 pm

Session Chair: L. Manchanda, AT&T Bell Laboratories

Session Chair: M. Schulz, Erlangen University

- 8:30 am Opening Remarks
- 8:45 am 1.1 "High-Quality Gate Oxide Films Based on Ultraclean Technology," *T. Ohmi*, Department of Electronic Engineering, Tohoku University, Sendai, Japan. (Invited)
- 9:30 am 1.2 "Silicon Surface and Interface Roughness: The Use of Fractals," *E. A. Irene*, Department of Chemistry, The University of North Carolina, Chapel Hill, North Carolina, USA. (Invited)
- 10:30 am 1.3 "Ferroelectric Thin Films for Memory Applications," *R. Moazzami*, Motorola Inc., APRDL, Austin, Texas, USA. (Invited)
- 11:15 am 1.4 "Reactions of Atomic Hydrogen at the Si/SiO<sub>2</sub> Interface," *E. Cartier*, IBM T. J. Watson Research Center, Yorktown Heights, New York, USA. (Invited)

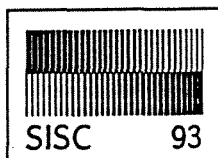
## Posters P1.1 - P2.4, Oral Summary

Thursday 12/9/93, 12:00 pm - 12:30 pm

Session Chair: L. Trombetta, University of Houston

Session Chair: J. Stathis, IBM T. J. Watson Research Center

- 12:00 pm P-1.1 "How Electron Heating Affects the Electron Capture Process by Interface Defects in Very Small MOSFET?," *D. Vuillaume, Z. M. Shi, J.-P. Miéville, and M. Dutoit*, Institut d'Électronique et de Microélectronique du Nord, ISEN, Lille, France.
- 12:03 pm P-1.2 "Effects of the Degradation of the Si-SiO<sub>2</sub> Interface Produced by Fowler-Nordheim Tunneling Injection on the Electron Mobility," *J. Banqueri, F. Gámiz, J. A. Jiménez-Tejada, J. E. Carceller, and J. A. López-Villanueva*, Departamento de Electrónica y Tecnología de Computadores, Universidad de Granada, Granada, Spain.
- 12:06 pm P-1.3 "Hot-Carrier Effects on Gate-Induced-Drain-Leakage (GIDL) Current in Thin-Film SOI/NMOSFET's," *B. Zhang and T. P. Ma*, Center for Microelectronic Materials & Structures and Department of Electrical Engineering, Yale University, New Haven, Connecticut, USA.
- 12:09 pm P-1.4 "Degradation of pMOSFETs Under Positive Bias Temperature Stress," *J. F. Zhang and W. Eccleston*, Department of Electrical and Electronic Engineering, Liverpool John Moores University, Liverpool, United Kingdom.
- 12:12 pm P-1.5 "Effect of Trapped Hole Annihilation by Tunnel Injection-Induced Electrons," *Y. Roh and L. Trombetta*, Department of Electrical Engineering, University of Houston, Houston, Texas, USA.



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- 12:15 pm P-1.6 "Theory of the Leis Model for Reversible Positive Charge Annealing," *K. C. Snyder, W. B. Fowler, and A. H. Edwards*, Physics Department, Lehigh University, Bethlehem, Pennsylvania, USA, and Department of Electrical Engineering, University of North Carolina at Charlotte, Charlotte, North Carolina, USA.
- 12:18 pm P-1.7 "A Numerical Analysis of Charge Trapping in MOSFETs with Thin Gate Dielectrics," *W. E. Wagner, R. E. Paulsen, and M. H. White*, Sherman Fairchild Center for Solid State Studies, Lehigh University, Bethlehem, Pennsylvania, USA.
- 12:21 pm P-2.1 "Paramagnetic Defects in Stain-Etched Porous Silicon," *G. J. Gerardi, F. C. Rong, E. H. Poindexter, and M. Harmatz*, William Paterson College, Wayne, New Jersey, USA, and Army Research Laboratory, Fort Monmouth, New Jersey, USA.
- 12:24 pm P-2.2 "Modification of Interfacial Stress by Thermal Nitridation: An Electron Spin Resonance Study of P<sub>b</sub> Center Structure in (111) Si/SiO<sub>2</sub> Systems," *J. T. Yount and P. M. Lenahan*, Department of Engineering Science and Mechanics, The Pennsylvania State University, University Park, Pennsylvania, USA.
- 12:27 pm P-2.3 "High Resolution Spin Dependent Recombination Study of Hot Carrier Damage in Short Channel MOSFETs: <sup>29</sup>Si Hyperfine Spectra," *J. W. Gabrys, P. M. Lenahan, and W. Weber*, Department of Engineering Science and Mechanics, The Pennsylvania State University, University Park, Pennsylvania, USA, and Corporate Research and Development, Siemens AG, Munich, Germany.
- 12:30 pm P-2.4 "Temperature Spin Dependent Recombination on Silicon Dangling Bonds," *D. Vuillaume, D. Deresmes, and D. Stiévenard*, Institut d'Électronique et de Microélectronique du Nord (IEMN), UMR, CNRS, Institut Supérieur d'Électronique du Nord (ISEN), Lille, France.

## SESSION 2

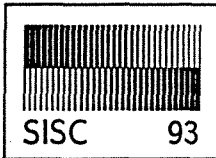
### Hot-Electron Degradation

Thursday 12/9/93, 2:00 pm - 3:35 pm

Session Chair: T. P. Ma, Yale University

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

- 2:00 pm 2.1 "Physical Understanding of Hot Carrier Stress in p-MOSFETs Relevant to Circuit Operation," *W. Weber, M. Brox, A. v. Schwerin, and R. Thewes*, Siemens AG, Munich, Germany. (Invited)
- 2:45 pm 2.2 "Experimental Evaluation of Anisotropic Impact Ionization in Si Utilizing Carrier Separation Technique," *S.-I. Takagi and A. Toriumi*, ULSI Research Laboratories, Toshiba Corporation, Kawasaki, Japan.
- 3:10 pm 2.3 "On the Influence of Mechanical Stress on MOSFET Hot-Carrier Degradation," *R. Degraeve, I. De Wolf, G. Groeseneken, and H. E. Maes*, IMEC, Leuven, Belgium.



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## SESSION 3

### Interface Traps, Carrier Trapping, Tunneling

Thursday 12/9/93, 4:00 pm - 5:40 pm

Session Chair: Y. Nishioka, Texas Instruments Japan

Session Chair: R. C. Barker, Yale University

- 4:00 pm 3.1 "Interface States Induced by Hole Trapping in Silicon Dioxide," *D. J. DiMaria, D. A. Buchanan, J. H. Stathis, and R. E. Stahlbush*, IBM T. J. Watson Research Center, Yorktown Heights, New York, USA, and Naval Research Lab, Washington, DC, USA.
- 4:25 pm 3.2 "Simple Method to Estimate MOS Oxide-Trap, Interface-Trap, and Border-Trap Densities," *D. M. Fleetwood, M. R. Shaneyfelt, and J. R. Schwank*, Sandia National Laboratories, Albuquerque, New Mexico, USA.
- 4:50 pm 3.3 "Calculation of the Fowler-Nordheim Tunneling Current Injected from the Energy Subbands of a Quantized Accumulation Layer," *J. A. López-Villanueva, I. Melchor, F. Gámiz, A. Palma, and J. E. Carceller*, Departamento de Electrónica y Tecnología de Computadores, Universidad de Granada, Granada, Spain.
- 5:15 pm 3.4 "Evaluation of the Coulomb Energy for Single-Electron Interface Trapping in Sub- $\mu\text{m}$  MOSFET's," *H. H. Mueller, D. Wörle, and M. Schulz*, Institute of Applied Physics, University of Erlangen-Nürnberg, Erlangen, Germany.

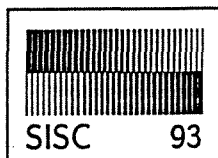
## Posters P3.1 - P5.2, Oral Summary

Thursday 12/9/93, 5:40 pm - 6:15 pm

Session Chair: N. Saks, Naval Research Lab

Session Chair: K. Taniguchi, Osaka University

- 5:40 pm P-3.1 "Random Telegraph Signals in Accumulation-Mode SOI/nMOSFETs," *M.-H. Tsai, B. Zhang, T. P. Ma, and L. K. Wang*, Center for Microelectronic Materials & Structures and Department of Electrical Engineering, Yale University, New Haven, Connecticut, USA, and IBM T. J. Watson Research Center, Yorktown Heights, New York, USA.
- 5:43 pm P-3.2 "Lateral Distribution of the Interface State and Its Applications to Drain-Engineered Design in Submicron MOS Devices," *S. S. Chung, G.-H. Lee, J.-J. Yang, C.-H. Tang, and P.-C. Chou*, Dept of Electronics Engineering, National Chiao Tung University, Taiwan, Republic of China.
- 5:46 pm P-3.3 "Correlation Between Trap-Generation and Charge-to-Breakdown in Ultrathin Oxides," *P. Apte and K. Saraswat*, Center for Integrated Systems, Stanford University, Stanford, California, USA.
- 5:49 pm P-3.4 "Defect Breakdown Lifetime Projection of Thin SiO<sub>2</sub> at Low Voltages," *K. F. Schurgraf and C. Hu*, Department of EECS, University of California, Berkeley, California, USA.



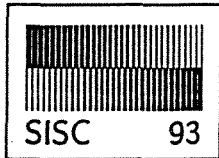
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- 5:52 pm P-4.1 "Photoinjection in SiO<sub>2</sub>-SiO<sub>2</sub>/Si Structures Formed by Wafer Bonding," *P. Ericsson and S. Bengtsson*, Department of Solid State Electronics, Chalmers University of Technology, Göteborg, Sweden.
- 5:55 pm P-4.2 "Free-Electron Lasers and Semiconductor Physics: First Results on Non-Linear Optics and Interfaces," *J. T. McKinley, R. G. Albridge, A. V. Barnes, P. A. Baudat, C. Coluzza, C. Dupuy, F. Gozzo, M. Illegems, J. L. Davidson, D. Martin, F. Morier-Genoud, A. Rudra, E. Tuncel, X. Yang, G. Margaritondo, and N. Tolk*, Department of Physics and Astronomy, Vanderbilt University, Nashville, Tennessee, USA, and École Polytechnique Fédérale, Lausanne, Switzerland.
- 5:58 pm P-4.3 "Oxidized Porous Si as a Luminescent Material," *T. Muschik, V. Petrova-Koch, D. Hofmann, D. Kovalev, A. Nikolov, and F. Koch*, Physik Department, Technische Universität München, Garching, Germany.
- 6:01 pm P-4.4 "Anneal Effects on the Growth and Structure of Silicon-Oxide Layers in the Ultra-Thin Regime," *S. A. Ajuria, A. Nghiem, P. U. Kenkare, and T. C. Mele*, Advanced Products Research and Development Lab, Motorola, Inc., Austin, Texas, USA.
- 6:04 pm P-4.5 "Hydrogen Distribution in Aluminum and Polysilicon Gate MOS Devices and the Influence on Radiation Induced Device Degradation," *J. Krauser, F. Wulf, S. Scharf, P. Fouladirad, and D. Bäunig*, Hahn-Meitner-Institut Berlin GmbH, Bereich Datenverarbeitung und Elektronik, Berlin, Germany.
- 6:07 pm P-4.6 "Effects of Nitrogen Contamination on Rapid Thermal Oxides," *G. A. Hames, J. J. Wortman, S. E. Beck, and D. A. Bohling*, Center for Advanced Electronic Materials Processing, North Carolina State University, Raleigh, NC 27695.
- 6:10 pm P-5.1 "Searching for the Two Electrically Active Defect Centers in the Lower Half of Bandgap at Irradiated (100)Si/SiO<sub>2</sub> Interface," *L. Vishnubhotla and T. P. Ma*, Center for Microelectronic Materials & Structures and Department of Electrical Engineering, Yale University, New Haven, Connecticut, USA.
- 6:13 pm P-5.2 "Time-Dependent Radiation Effects in BESOI Structures with Different Insulating Layers," *H. E. Boesch, Jr., C. A. Pennise, G. Goetz, and J. B. McKitterick*, U. S. Army Research Laboratory, Adelphi, Maryland, USA, and Allied Signal Aerospace Company, Columbia, Maryland, USA.



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## SESSION 4

### Defects in SiO<sub>2</sub> and at the Si/SiO<sub>2</sub> Interface

Friday 12/10/93, 8:15 am - 12:15 pm

Session Chair: A. M. Stoneham, AEA Technology

Session Chair: A. H. Edwards, Univ. North Carolina - Charlotte

- 8:15 am 4.1 "Structural Aspects of Intrinsic Defects at Thermally Grown Si/SiO<sub>2</sub> Interfaces Analyzed by ESR," *A. Stesmans*, Department of Physics, University of Leuven, Leuven, Belgium. (Invited)
- 9:00 am 4.2 "Delocalized Spin Centers in SiO<sub>2</sub> Thin Films," *W. L. Warren, D. M. Fleetwood, M. R. Shaneyfelt, J. R. Schwank, P. S. Winokur, and R. A. B. Devine*, Sandia National Laboratories, Advanced Materials Laboratory, Albuquerque, New Mexico, USA, and CNET/France Télécom, Meylan, France.
- 9:25 am 4.3 "Hydrogen Reactions with P<sub>b</sub> Centers at (100) and (111) Interfaces," *J. Stathis and E. Cartier*, IBM T. J. Watson Research Center, Yorktown Heights, New York, USA.
- 9:50 am 4.4 "Theory of Nitrogen Defects in Silicon Dioxide," *K. C. Snyder and W. B. Fowler*, Physics Department, Lehigh University, Bethlehem, Pennsylvania, USA.
- 10:35 am 4.5 "Predicting the Density of P<sub>b</sub> Defects at the Si/SiO<sub>2</sub> Interface," *S. C. Jain, A. H. Harker, and A. M. Stoneham*, AEA Industrial Technology, Harwell Laboratory, Didcot, Oxfordshire, United Kingdom.
- 11:00 am 4.6 "Interaction of Hydrogen with E' Centers in SiO<sub>2</sub>," *A. H. Edwards and R. E. Stahlbush*, Department of Electrical Engineering, University of North Carolina at Charlotte, Charlotte, North Carolina, USA, and Naval Research Laboratory, Washington, DC, USA.
- 11:25 am 4.7 "Defect Generation in 3.5 nm Silicon Dioxide Films," *D. A. Buchanan, D. J. DiMaria, C.-A. Chang, and Y. Taur*, IBM T. J. Watson Research Center, Yorktown Heights, New York, USA.
- 11:50 am 4.8 "Point Defect Generation and Oxide Degradation During Annealing of the Si-SiO<sub>2</sub> Interface," *R. A. B. Devine, W. L. Warren, and D. M. Fleetwood*, Centre National d'Études des Télécommunications/France Télécom, Meylan, France, and Sandia National Laboratories, Advanced Materials Laboratory, Albuquerque, New Mexico, USA.

## SESSION 5

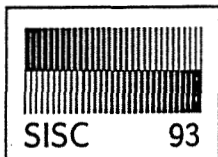
### Radiation Effects

Friday 12/10/93, 2:00 pm - 3:25 pm

Session Chair: H. E. Boesch, Army Research Lab

Session Chair: G. Groseneken, IMEC

- 2:00 pm 5.1 "Radiation and Hot-Electron Effects in SIMOX/MOSFETs," *S. Cristoloveanu*, LPCS/ENSERG, Grenoble, France. (Invited)



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- 2:45 pm 5.2 "Experimental Evidence of Two Species of Radiation-Induced Trapped Positive Charge," *R. K. Freitag, D. B. Brown, and C. M. Dozier*, Naval Research Laboratory, Washington, DC, USA.
- 3:10 pm 5.3 "Evidence for "New" E' Defects in VUV Irradiated Thermally Grown SiO<sub>2</sub>," *J. F. Conley, Jr., P. M. Lenahan, R. Lowry, H. Evans, T. Morthorst*, Department of Engineering Science and Mechanics, The Pennsylvania State University, University Park, Pennsylvania, USA, Harris Semiconductor, Melbourne, Florida, USA, and Harris Semiconductor, Findlay, Ohio, USA.

### PANEL SESSION 6 3-5 nm Ultrathin Dielectrics

Friday 12/10/93, 3:45 pm - 5:30 pm

Panel Moderator: **W. T. Lynch, Semiconductor Research Corp.**

"Degradation and Breakdown in Silicon Dioxide," *D. J. DiMaria*, IBM T. J. Watson Research Lab, Yorktown Heights, NY, USA.

"State-of-the-Art Cleaning Technology and its Influence on the Gate Oxide and the Si/SiO<sub>2</sub> Interface Quality," *T. Ohmi*, Tohoku University, Sendai, Japan.

"SiO<sub>2</sub>/Si Interface Structures and Traps in SiO<sub>2</sub>," *A. Ishitani*, ULSI Device Lab, NEC, Kanagawa, Japan.

"Characterization of Process-Induced Interface Degradation," *R. Devine*, Centre National d'Études des Télécommunications, Meylan, France.

"Electrical Characterization of Ultrathin Dielectrics," *K. R. Farmer*, New Jersey Institute of Technology, Newark, New Jersey, USA.

### SESSION 7

#### Trapped Holes, Interface Traps, Point Defects

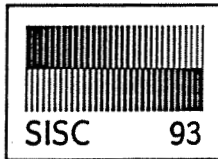
Saturday 12/11/93, 8:15 am - 10:10 am

Session Chair: **R. Stahlbush, Naval Research Lab**

Session Chair: **E. Nicollian, Univ. North Carolina - Charlotte**

- 8:15 am 7.1 "Self-Trapped Holes in Amorphous Silicon Dioxide Layers," *D. Griscom*, Naval Research Laboratory, Washington, DC, USA. (Invited)
- 9:00 am 7.2 "An Overview of Radiation Induced Interface Traps and Other Defects," *T. R. Oldham, F. B. McLean, H. E. Boesch, and J. M. McGarrity*, Army Research Laboratory, Adelphi, Maryland, USA. (Invited)
- 9:45 am 7.3 "Generation Kinetics of a Point Defect Which is Characteristic of Buried Thermal Oxides," *M. E. Zvanut, R. E. Stahlbush, E. S. Steigerwalt, and G. A. Brown*, Department of Physics, The University of Alabama at Birmingham, Birmingham, Alabama, USA, Naval Research Laboratory, Washington, DC, USA, and Texas Instruments, Dallas, Texas, USA.





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## SESSION 8

### Interface Roughness and Mobility, N<sub>2</sub>O Dielectrics

Saturday 12/11/93, 10:30 am - 12:30 am

Session Chair: G. Higashi, AT&T Bell Laboratories

Session Chair: H.-H. Tseng, Motorola Corp.

- 10:30 am 8.1 "SiO<sub>2</sub>/Si(100) Interface Roughness Measured with X-Ray Diffraction,"  
*K. Evans-Lutterodt, M.-T. Tang, M. L. Green, D. Brasen, K. Krisch, L. Manchanda, G. S. Higashi, and T. Boone, AT&T Bell Laboratories, Murray Hill, New Jersey, USA. (Invited)*
- 11:15 am 8.2 "New Surface Roughness Mobility Model for Silicon MOS Transistors,"  
*K. Rais, G. Ghibaudo, and F. Balestra, Laboratoire de Physique des Composants à Semiconducteurs, ENSERG, Grenoble, France.*
- 11:40 am 8.3 "Compositional and Chemical Depth Profiling of Nitrogen in N<sub>2</sub>O-Grown Oxides Using X-Ray Photoelectron Spectroscopy," *E. C. Carr and R. A. Buhrman, Department of Applied Physics, Cornell University, Ithaca, New York, USA.*
- 12:05 pm 8.4 "Determination of Nitrogen Content of N<sub>2</sub>O-Grown Oxynitride Films by a Nuclear Reaction Technique," *B. Brasen, L. C. Feldman, M. L. Green, K. Krisch, W. Lennard, W.-C. Liang, L. Manchanda, N. Moriya, H. Nussbaumer, H. Tang, G. Weber, and B. Weir, AT&T Bell Laboratories, Murray-Hill, New Jersey, USA, AT&T Bell Laboratories, Holmdel, New Jersey, USA, and University of Western Ontario, London, Ontario, Canada.*
- 12:30 pm **Closing Remarks and Adjournment of SISC93**