
Semiconductors, Dielectrics, and Metals for Nanoelectronics 12

Editors:**S. Kar**

Indian Institute of Technology
Kanpur, India

S. Van Elshocht

IMEC
Leuven, Belgium

K. Kita

University of Tokyo
Tokyo, Japan

S. Dayeh

University of California
San Diego, California, USA

M. Houssa

University of Leuven
Leuven, Belgium

D. Misra

New Jersey Institute of Technology
Newark, New Jersey, USA

D. Landheer

National Research Council Canada
Ottawa, Ontario, Canada

H. Jagannathan

IBM Research
Albany, New York, USA

Sponsoring Divisions:**Dielectric Science & Technology****Electronics and Photonics**

Published by

The Electrochemical Society65 South Main Street, Building D
Pennington, NJ 08534-2839, USA

tel 609 737 1902

fax 609 737 2743

www.electrochem.org

ecs transactions™**Vol. 64, No. 8**

Copyright 2014 by The Electrochemical Society.
All rights reserved.

This book has been registered with Copyright Clearance Center.
For further information, please contact the Copyright Clearance Center,
Salem, Massachusetts.

Published by:

The Electrochemical Society
65 South Main Street
Pennington, New Jersey 08534-2839, USA

Telephone 609.737.1902
Fax 609.737.2743
e-mail: ecs@electrochem.org
Web: www.electrochem.org

ISSN 1938-6737 (online)
ISSN 1938-5862 (print)
ISSN 2151-2051 (cd-rom)

ISBN 978-1-62332-188-8 (Hard Cover)
ISBN 978-1-60768-545-6 (PDF)

Printed in the United States of America.

ECS Transactions, Volume 64, Issue 8
Semiconductors, Dielectrics, and Metals for Nanoelectronics 12

Table of Contents

Preface *iii*

**Chapter 1
Defects, Traps, and Reliability**

(Invited) Molecular Dynamics Simulation of Dipole Layer Formation at High-k/SiO ₂ Interfaces <i>T. Watanabe, R. Kuriyama, M. Hashiguchi, R. Takahashi, K. Shimura, A. Ogura, S. Satoh</i>	3
(Invited) Spectroscopy of Deep Gap States in High-k Insulators <i>V. V. Afanas'ev, W. C. Wang, F. Cerbu, O. Madia, M. Houssa, A. Stesmans</i>	17
Control of 4H-SiC (0001) Thermal Oxidation Process for Reduction of Interface State Density <i>K. Kita, R. H. Kikuchi, H. Hirai, Y. Fujino</i>	23
Effect of Al Doping on the Reliability of ALD HfO ₂ <i>M. Bhuyian, D. Misra, K. Tapily, R. Clark, S. Consiglio, C. Wajda, G. Nakamura, G. Leusink</i>	29
High-Temperature Reverse-Bias Stressing of Thin Gate Oxides in Power Transistors <i>S. A. Suliman, O. O. Awadelkarim, J. Hao, M. Rioux</i>	45

**Chapter 2
Ge and Si/Ge Channels**

(Invited) High Electron Mobility n-Channel Ge MOSFETs with Sub-Nm EOT <i>A. Toriumi, C. Lee, C. Lu, T. Nishimura</i>	55
---	----

(Invited) In Depth Study of Ge Impact on Advanced SiGe PMOS Transistors <i>A. Soussou, M. Cassé, G. Reimbold, C. Leroux, F. Andrieu, D. Rideau, V. Delaye, M. Juhel, R. Berthelon, G. Ghibaudo, C. Tavernier</i>	61
ALD Grown Rare-Earth High-k Oxides on Ge: Lowering of the Interface Trap Density and EOT Scalability <i>O. Bethge, C. Zimmerman, B. Lutzer, S. Simsek, S. Abermann, E. Bertagnolli</i>	69
Ambient-Pressure XPS Study of GeO ₂ /Ge(100) and SiO ₂ /Si(100) at Controlled Relative Humidity <i>K. Arima, Y. Kawai, Y. Minoura, Y. Saito, D. Mori, H. Oka, K. Kawai, T. Hosoi, Z. Liu, H. Watanabe, M. Morita</i>	77

Chapter 3 **Nano-technology**

In Situ TEM Study on Au Mediated Growth of NiSi ₂ in Si Nanowire: A Vapor-Liquid-Solid Analogy <i>W. Tang, S. T. Picraux, X. Liu, K. N. Tu, S. A. Dayeh</i>	85
(Invited) Epitaxial Growth of Nanodots on Si Substrates with Controlled Interfaces and Their Application to Electronics and Thermoelectronics <i>Y. Nakamura, A. Sakai</i>	91
Influence of Surface States on Electronic Band Structure and Electron Density in InAs Nanowires and InAs Shell Nanowires <i>N. Demarina, D. Grützmacher</i>	95
Dynamical Imaging of Nickel Disilicide Nucleation and Step Flow Propagation in Defect-Engineered Si Nanowire <i>W. Tang, S. T. Picraux, A. M. Gusak, K. N. Tu, S. A. Dayeh</i>	101

Chapter 4 **2D Semiconductors**

(Invited) Interaction of Silicene and Germanene with Non-Metallic Substrates <i>M. Houssa, E. Scalise, B. van den Broek, A. Lu, G. Pourtois, V. V. Afanas'ev, A. Stesmans</i>	111
--	-----

(Invited) Doping, Functionalization, and Permeability of Graphene: Insights from First-Principles Studies <i>L. Tsetseris, B. Wang, S. T. Pantelides</i>	121
Electrical Characteristics of Multilayer MoS ₂ Transistors at Real Operating Temperatures and Different Ambient Conditions <i>H. J. Kwon, J. Jang, H. Kang, S. Kim, V. Subramanian, C. P. Grigoropoulos</i>	127
Characteristics of Inkjet-Printed Separators in Graphene-Based Supercapacitors <i>Y. S. Yang, I. K. You, S. H. Hong, H. G. Yun</i>	135

Chapter 5 Memory

(Invited) Investigation of Frenkel-Pair Formation in HfO ₂ and Its Influence on OxRAM Memory Reliability <i>E. Vianello, P. Blaise, B. Traoré, K. Xue, L. Fonseca, G. Molas, B. de Salvo, L. Perniola, Y. Nishi</i>	141
(Invited) Resistive Switching Characteristics and Controllable Quantized Conductance in Single-Crystal Anatase TiO ₂ on Si (001) <i>E. T. Yu, C. Hu, M. D. McDaniel, A. B. Posadas, A. A. Demkov, J. G. Ekerdt</i>	147
(Invited) The Interplay between Electronic and Ionic Transport in the Resistive Switching Process of Random Access Memory Devices <i>B. Magyari-Kope, L. Zhao, K. Kamiya, M. Y. Yang, M. Niwa, K. Shiraishi, Y. Nishi</i>	153
(Invited) Ferroelectric Hafnium Oxide Based Materials and Devices: Assessment of Current Status and Future Prospects <i>J. Müller, P. Polakowski, S. Müller, T. Mikolajick</i>	159
(Invited) Stress-Induced Asymmetric Switching and Filament Instability in Electrochemical Memories <i>D. Ielmini, S. Ambrogio, S. Balatti</i>	169

Chapter 6

Photonics and Dielectrics

Fabrication and Physical Properties of Thin Films TiN _x for Infrared Absorption <i>B. Jiang, T. Dong, Y. He, Z. Yang, Y. Su, K. Wang</i>	179
Fabrication and Characteristic of Wrinkled Stiff Thin Films on Elastomeric Substrates by Surface Treatments <i>S. C. Lim, J. B. Koo, C. W. Park, J. Y. Oh, S. W. Jung, B. S. Na, S. S. Lee, H. Y. Chu</i>	185
Author Index	189