

TABLE OF CONTENTS

ANALYTICAL AND DIAGNOSTIC TECHNIQUES FOR SEMICONDUCTOR MATERIALS, DEVICES AND PROCESSES

PREFACE

ALTECH 2003 "Analytical Techniques for Semiconductor Materials and Process Characterization IV"

PART 1 "Impurities: Metals, Non-Metals and Organics"

Copper Behavior in Bulk Silicon and Associated Characterization Techniques *	5
<i>T. Heiser, A. Belayachi and J.-P. Schunck</i>	
Quantification Issues of Trace Metal Contaminants on Silicon Wafers by Means of TOF-SIMS and ICP-MS	21
<i>P. Rostam-Khani, P. Vullings, G. Noij, and W. Claassen</i>	
Determination of the Aluminum-Induced Oxide Charge by AC Surface Photovoltage Measurements in N-Type Silicon	31
<i>H. Shimizu, M. Ikeda and R. Shin</i>	
Characterization of Heavy Metal Contamination by Capacitance-Frequency Method	37
<i>K. Hara, M. Takahashi, H. Yoshida and S. Kishino</i>	
In-line Copper Contamination Monitoring Using Non-Contact Q-V-SPV Techniques	42
<i>M. Böhringer, J. Hauber, S. Passefort and K. Eason</i>	
Recent Developments in Nuclear Methods in Support of Semiconductor Characterization *	50
<i>B. Brijs, H. Bender, C. Huyghebaert, T. Janssens, W. Vandervorst, K. Nakajima, K. Kimura, A. Bergmaier, G. Dollinger and J. A. van den Berg</i>	

* invited paper

Determination of Oxygen in Semiconductor Silicon by Gas Fusion Analysis GFA – Historical and Future Trends *	63
<i>S. Pahlke</i>	
High Sensitivity Measurement of Nitrogen in Czochralski Silicon	75
<i>M. Porrini, M. G. Pretto, R. Scala and V.V. Voronkov</i>	
Spark Source Mass Spectrometric Analysis of Low Carbon Contents in Crystalline Silicon	83
<i>B. Wiedemann, J. D. Meyer, H. C. Alt and H. Riemann</i>	
Hydrogen Contamination and Defect Generation in p-type Silicon and Silicon-Germanium Schottky Barrier Test Structures	88
<i>F. Volpi, A. R. Peaker, I. Berbezier and A. Ronda</i>	
Analysis of Oxygen Thermal Donor Formation in n-type Cz-Silicon	96
<i>J.M. Rafi, E. Simoen, C. Claeys, A. Ulyashin, R. Job, W. Fahrner, J. Versluys, P. Clauws, M. Lozano and F. Campabadal</i>	
The Application of Synchrotron Radiation to Semiconductor Materials Characterization *	106
<i>R. Barrett</i>	
Ultra-trace Analysis of Light Elements and Speciation of Minute Organic Contaminants on Silicon Wafer Surfaces by means of TXRF in Combination with NEXAFS	120
<i>B. Beckhoff, R. Fliegau, G. Ulm, J. Weser, G. Pepponi, C. Strel, P. Wobrauschek, T. Ehmman, L. Fabry, C. Mantler, S. Pahlke, B. Kanngiesser and W. Malzer</i>	
TXRF Characterization of Inhomogeneous Solids: Influence of Surface Morphology	129
<i>N. Alov, K. Oskolok, A. Wittershagen and B. O. Kolbesen</i>	
Characterization of Trace Organic Contamination on Silicon Surfaces in Semiconductor Manufacturing *	136
<i>K. Saga and T. Hattori</i>	

* invited paper

Characterization of Advanced Semiconductor Materials by Thermal Desorption Mass Spectrometry with Atmospheric, Pressure Ionization <i>L. Carbonell, G. Vereecke, S. Van Elshocht, M. Caymax, M. Van Hove, K. Maex and P. Mertens</i>	150
Analysis of Trace VOCs' in Clean Room Air with PDMS/Carboxen SPME Fibers <i>L. Tuduri, V. Teetaert, V. Desauziers, E. Coffre, P. Dupont and M. Camenzind</i>	160
Cleaning Chemistry with Complexing Agents (CAs): Direct Concentration Measurement of CAs with HPLC <i>S. Metzger and B.O. Kolbesen</i>	170
Complexing Agents (CAs) for Semiconductor Cleaning Chemistries: Characterization of CA Lifetimes by UV/VIS-Spectroscopy <i>O. Doll and B. O. Kolbesen</i>	177

Part 2 "Thin Films"

Stress Management in IC Manufacturing: μ -Raman Spectroscopy Revisited * <i>L.F.T. Kwakman, D. Delille, M. Mermoux, A. Crisci and G. Lucazeau</i>	189
Characterization and Metrology of Novel Materials Involved in Advanced CMOS Processes * <i>C. Wyon</i>	207
Physical Characterization of Thin HfO ₂ Layers by the Combined Analysis with Complementary Techniques <i>H. Bender, T. Conard, O. Richard, B. Brijs, J. Pétry, W. Vandervorst, C. Defranoux, P. Boher, N. Rochat, C. Wyon, P. Mack, J. Wolstenholme, R. Vitchev, L. Houssiau, J-J. Pireaux, A. Bergmaier and G. Dollinger</i>	223

Analytical Characterization of Process Parameter Influence on the Initial Growth and Crystallinity of Atomic Layer Deposition HfO ₂ Thin Films <i>D. Blin, N. Rochat, G. Rolland, P. Holliger, F. Martin, J.-F. Damlencourt, T. Lardin, P. Besson, S. Haukka and M.-N. Séméria</i>	233
Application of X-Ray Fluorescence Spectrometry in Characterization of High-k Ultra-Thin Films <i>C. Zhao, B. Brijs, F. Dortu, S. DeGendt, M. Caymax, M. Heyns, W. Besling and J. W. Maes</i>	243
Characterization of Nano-Laminate Structure Using Grazing Incidence XRD and ATR-FTIR <i>C. Zhao, S. DeGendt, M. Caymax, M. Heyns, V. Consier, J. W. Maes, G. Roebben and O. Van Der Biest</i>	252
High-Resolution Analysis of the HfO ₂ -SiO ₂ Interface by Soft X-Ray Photoelectron Spectroscopy <i>O. Renault, D. Samour, J. -F. Damlencourt, A. -M. Papon, F. Martin, S. Marthon, D. Blin and N. T. Barrett</i>	260
Ag Electrodeposition on n-InP Followed in Situ by Photoluminescence <i>I. Gérard, C. Mathieu, P. Tran-Van, and A. Etcheberry</i>	267
Characterization by Electrochemistry and Chemical Surface Analysis of an Oxide Film on n-InP <i>N.C. Quach, I. Gérard, N. Simon and A. Etcheberry</i>	276
Charging Effects on Ferroelectric SBT Thin Films Imaged by Non-Contact Electrostatic Force Microscopy <i>N. Junghans and B.O. Kolbesen</i>	285
Two Dimensional Carrier Profiling Using Scanning Capacitance Microscopy <i>N. Duhayon, T. Clarysse, D. Alvarez, P. Eyben, M. Fouchier, W. Vandervorst and L. Hellemans</i>	293

Part 3 "Non-Destructive and Optical Methods"

- Spectroscopic Ellipsometry in the VUV Range Applied to the Characterization of Atomic Layer Deposited HfO_2 , Al_2O_3 and HfAlO_x Thin Layers for High k Dielectrics
P. Boher, C. Defranoux, S. Bourtauld, J. P. Piel and H. Bender 305
- Optical Characterisation of High- κ Materials Deposited by ALCVD
E. Bellandi, B. Crivelli, A. Elbaz, M. Alessandri, P. Boher and C. Defranoux 316
- Macroscopic and Microscopic Photoluminescence Mapping System Applicable to 300 mm Wafers
Z. Li, M. Tajima and R. Shimidzu 322
- In-Line and Non-Destructive Analysis of Epitaxial $\text{Si}_{1-x-y}\text{Ge}_x\text{C}_y$ by Spectroscopic Ellipsometry and Comparison with Other Established Techniques
R. Loo, P. Meunier-Beillard, R. Delhougne, T. Koumoto, L. Geenen, B. Brijs and W. Vandervorst 329
- Study by Spectroellipsometry of the InP Surface Evolution by Cerium Acidic Solution
B. Canava, J. Vigneron, A. Etcheberry, M. Stchakovsky and J. P. Gaston 339
- Characterisation of Bulk and Surface Properties in Semiconductors Using Non-Contacting Techniques
A. Castaldini, D. Cavalcoli, A. Cavallini and M. Rossi 346

Part 4 "Characterization of Defects, Technology and Devices"

- Focused Ion Beam Analysis of Cu/Low-k Metallization Structures *
H. Bender 357

* invited paper

Characterization and Mechanism of Device Failure due to Hollow Via Formation <i>C. Hatcher, R. Lappan, J. Prasad and M. Engle</i>	373
ZrO ₂ as Dielectric Material for Device Characterization with Scanning Capacitance Microscopy <i>W. Brezna, S. Harasek, H. Enichlmair, E. Bertagnolli, E. Gornik and J. Smoliner</i>	378
Potential and Pitfalls of the Diode Characterization Technique for ULSI Device Analysis <i>A. Poyai, E. Simoen and C. Claeys</i>	386
In-Situ Electrochemical Sensor for Early Detection of Plating Problems in Copper Metallization Process <i>A. Jaworski and K. Wikiel</i>	396

SYMPOSIUM M1

Diagnostic Techniques for Semiconductor Materials and Devices

Overview of Techniques

Semiconductor Metrology Requirements over the Next 15 Years * <i>A. C. Diebold</i>	409
Noise Diagnostics of Advanced Silicon Substrates and Deep Submicron Process Modules * <i>E. Simoen, A. Mercha and C. Claeys</i>	420
High Resolution X-Ray Reflectometry: Theory, Practice, Accuracy and Precision * <i>R. J. Matyi</i>	440
Watching Chips Work: Optical Imaging of Hot Carriers in ICs * <i>J. C. Tsang</i>	455

* *invited paper*

Measurement of Local Strain in Semiconductor Materials by Using Synchrotron X-Ray Microbeam *	467
<i>J. Matsui, Y. Tsusaka, Y. Kagoshima and K. Yokoyama</i>	
Impurities, Capacitance and Optical Techniques	
Direct Observation of Substitutional and Interstitial Iron Atoms in Silicon by High-Temperature and In-Beam Mössbauer Spectroscopy *	479
<i>Y. Yoshida</i>	
Quantitative Evaluation of Iron at the Silicon Surface after Wet Cleaning Treatments	493
<i>D. Caputo, P. Bacciaglia, C. Carpanese, M.L. Polignano, P. Lazzeri, M. Bersani, L. Vanzetti, P. Pianetta and L. Moro</i>	
Influence of Cobalt Contamination in the Measurement of Diffusion Length of p-type CZ Silicon Wafers	505
<i>N. Pic, M. L. Polignano, D. Caputo, G. Salvà, M. Sardo and A. Danel</i>	
Nitrogen Concentration Measurement of CZ Silicon *	516
<i>N. Inoue, N. Fujiyama and H. Yagi</i>	
Extraction of the Capacitance of Ultrathin High- κ Gate Dielectrics	527
<i>S. Kar</i>	
Optical Surface Analysis of Transparent Substrates for Manufacturing Applications	540
<i>L. Bechtler, V. Velidandla and G. Lane</i>	
AUTHOR INDEX	548
SUBJECT INDEX	551

* *invited paper*