
Atomic Layer Deposition Applications 10

Editors:

F. Roozeboom

Eindhoven University of Technology
and
TNO Eindhoven
Eindhoven, The Netherlands

S. De Gendt

IMEC
and
Catholic University (KU Leuven)
Leuven, Belgium

A. Delabie

IMEC
and
Catholic University (KU Leuven)
Leuven, Belgium

J. W. Elam

Argonne National Laboratory
Argonne, Illinois, USA

A. Londergan

Qualcomm Technologies, Inc.
Santa Clara, California, USA

O. van der Straten

IBM Research
Albany, New York, USA

Sponsoring Divisions:



Dielectric Science & Technology



Electronics and Photonics



Published by

The Electrochemical Society

65 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. 9

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 978-1-62332-189-5 (Hard Cover)
ISBN 978-1-60768-546-3 (PDF)

Printed in the United States of America.

Table of Contents

Preface	iii
---------	-----

Chapter 1 General ALD Session

Atomic Layer Deposition of Nanostructured Tunable Resistance Coatings: Growth, Characterization, and Electrical Properties <i>A. U. Mane, W. M. Tong, A. D. Brodie, M. A. McCord, J. W. Elam</i>	3
--	---

Study of Y_2O_3 Thin Film Prepared by Plasma Enhanced Atomic Layer Deposition <i>G. Y. Cho, S. Noh, Y. H. Lee, S. Ji, S. W. Cha</i>	15
--	----

ALD Applied to Conformal Rare-Earth Coating of ZnO Nanoparticles for Low Temperature Thermal Imaging Applications <i>E. Rauwel, A. Galeckas, P. Rauwel, P. A. Hansen, D. Wragg, O. Nilsen, H. Fjellvåg</i>	23
--	----

Chapter 2 ALD Reactor Design

Merits of Batch ALD <i>G. Dingemans, B. Jongbloed, W. Knaepen, D. Pierreux, L. Jdira, H. Terhorst</i>	35
--	----

Plasma Enhanced Atomic Layer Deposition on Powders <i>G. Rampelberg, D. Longrie, D. Deduytsche, C. Detavernier</i>	51
---	----

Multiscale Simulations of ALD in Cross Flow Reactors <i>A. Yanguas-Gil, J. A. Libera, J. W. Elam</i>	63
---	----

Design Considerations for ZnO Transistors Made Using Spatial ALD <i>S. F. Nelson, C. R. Ellinger, L. W. Tutt</i>	73
---	----

Chapter 3 Molecular Layer Deposition

Molecular Layer Deposition of Nanoscale Organic Films for Nanoelectronics Applications <i>D. Bergsman, H. Zhou, S. F. Bent</i>	87
---	----

Highly Luminescent Monolayers Prepared by Molecular Layer Deposition <i>A. Räupke, F. Albrecht, J. Maibach, A. Behrendt, A. Polywka, R. Heiderhoff, J. Helzel, T. Rabe, H. H. Johannes, W. Kowalsky, E. Mankel, T. Mayer, P. Görnn, T. Riedl</i>	97
---	----

Chapter 4 Advanced Semiconductor Applications

<i>In-Situ</i> Studies on 2D Materials <i>R. M. Wallace</i>	109
--	-----

ALD and PVD Tantalum Nitride Barrier Resistivity and Their Significance in via Resistance Trends <i>O. van der Straten, X. Zhang, K. Motoyama, C. Penny, J. Maniscalco, S. Knupp</i>	117
---	-----

Higher-K Formation in Atomic Layer Deposited $\text{Hf}_{1-x}\text{Al}_x\text{O}_y$ <i>K. Tapily, S. Consiglio, R. Clark, R. Vasic, C. Wajda, J. Jordan-Sweet, G. Leusink, A. C. Diebold</i>	123
---	-----

Engineering the III-V Gate Stack Properties by Optimization of the ALD Process <i>S. Sioncke, L. Nyns, T. Ivanov, D. Lin, J. Franco, A. Vais, M. Ameen, A. Delabie, Q. Xie, J. W. Maes, F. Tang, M. Givens, S. Van Elshocht, F. Holsteens, K. Barla, N. Collaert, A. Thean, S. De Gendt, M. Heyns</i>	133
--	-----

Chapter 5 New ALD Materials and Processes

Manganese Precursor Selection and the Thermal Atomic Layer Deposition of Copper/Manganese Alloy Films <i>L. C. Kalutarage, S. B. Clendenning, C. H. Winter</i>	147
---	-----

Promoted Platinum Catalytic Activity and Thermal Stability with Nano-Scale Cobalt Oxide Coating via Atomic Layer Deposition	159
<i>K. Cao, B. Huang, Y. Zhang, X. Liu, B. Shan, R. Chen</i>	
Flash-Lamp-Enhanced Atomic Layer Deposition of Thin Films	167
<i>T. Henke, M. Knaut, C. Hossbach, M. Geidel, L. Rebohle, M. Albert, W. Skorupa, J. W. Bartha</i>	

Chapter 6 Poster Session

RF Power Effect of Post-Deposition Oxygen Plasma Treatment on HfO ₂ Gate Dielectrics	193
<i>T. C. Bo, Y. L. Cheng</i>	
Mechanical/Structural Properties of ALD Zirconium Oxide (ZrO ₂) Thin Films for High-Tech Applications	205
<i>M. A. Mamun, H. Baumgart, A. A. Elmoustafa</i>	
Nanomechanical Properties of Tungsten Trioxide (WO ₃) Grown by Atomic Layer Deposition	211
<i>M. A. Mamun, K. Zhang, H. Baumgart, A. A. Elmoustafa</i>	

Chapter 7 New Materials and Processes

Heteroleptic Precursors for Atomic Layer Deposition	221
<i>J. Niinistö, T. Blanquart, S. Seppälä, M. Ritala, M. Leskelä</i>	
Design, Synthesis and ALD Assessment of Organometallic Precursors for Semiconductor Applications	233
<i>C. Dussarrat</i>	
Thin-film Deposition of Silicon Nitrides and Oxides from Trihydridosilanes	243
<i>B. Arkles, Y. Pan, A. Kaloyerous</i>	

Chapter 8 Energy Applications

Selective-Area Atomic Layer Deposition of Copper Nanostructures for Direct Electro-Optical Solar Energy Conversion <i>B. G. Willis, J. Qi, X. Jiang, J. Chen, G. J. Weisel, D. T. Zimmerman</i>	253
--	-----

The Effect of SPA-SiO ₂ Tunnel Oxide Thickness for Metal-Insulator-Silicon Photoelectrochemical Cells <i>A. G. Scheuermann, D. Q. Lu, T. Ito, C. E. D. Chidsey, P. C. McIntyre</i>	265
--	-----

Chapter 9 Plasmonics/Closing Remarks

Self Assembled Metamaterials Formed via Plasma Enhanced ALD of Ag Thin Films <i>S. M. Prokes, O. J. Glembocki</i>	279
--	-----

Plasmonics and Metamaterials with Transparent Conducting Oxides <i>M. Abb, Y. Wang, D. Traviss, R. Bruck, C. H. de Groot, H. Chong, B. Sepulveda, O. L. Muskens</i>	291
--	-----

Author Index	299
--------------	-----