
Gallium Nitride and Silicon Carbide Power Technologies 9

Editors:

M. Dudley

B. Raghoeamachar

N. Ohtani

M. Bakowski

K. Shenai

Sponsoring Division:



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

ecstransactions™

Vol. 92, No. 7

Copyright 2019 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 978-1-62332-588-6 (CD-ROM)
ISBN 978-1-62332-589-3 (USB)
ISBN 978-1-60768-881-5 (PDF)

Printed in the United States of America.

Table of Contents

Preface *iii*

Chapter 1 General Wide Bandgap Technologies

(Invited) Emerging Role of Silicon Carbide and Gallium Nitride Based Power Electronics in Power and Transportation Sectors 3

P. Paniyil, R. Singh

(Invited) Comparison of High Voltage, Vertical Geometry Ga₂O₃ Rectifiers with GaN and SiC 15

J. Yang, C. Fares, P. H. Carey IV, M. Xian, F. Ren, M. J. Tadjer, Y. T. Chen, Y. T. Liao, C. W. Chang, J. Lin, R. Sharma, M. E. Law, P. E. Raad, P. L. Komarov, D. J. Smith, A. Kuramata, S. J. Pearton

Optimization of Doping Profiles in Insulated-Gate Bipolar-Transistors Using a Large Scale Optimization Technique 25

C. Zhu, P. Andrei

Chapter 2 SiC Technologies

(Invited) Unified Understanding of the Shockley Stacking Fault Formation in 4H-SiC Crystals under Thermal Equilibrium and Non-Thermal Equilibrium Conditions Based on the Quantum Well Action Concept 39

N. Ohtani

Safe Operation of Maximum Temperature for Planar Gate SiC Mosfet under Avalanche Stress Shock 49

X. Li, Z. Hou, X. Tong, X. Deng, J. Jiang, Y. Zhang, B. Zhang

Chapter 3

GaN Technologies

Radiation-Induced DC Parametric Degradation of Enhancement Mode GaN-on-(111)Silicon High-Electron-Mobility Transistors <i>Y. Lu, A. Christou</i>	57
---	----

Chapter 4

Gallium Oxide Technologies

(Invited) Electrical Properties of (100) β -Ga ₂ O ₃ Schottky Diodes with Four Different Metals <i>K. Jiang, L. A. M. Lyle, E. Favela, D. Moody, T. Lin, K. K. Das, A. Popp, Z. Galazka, G. Wagner, L. M. Porter</i>	71
Band Offsets of Insulating & Semiconducting Oxides on (Al _x Ga _{1-x})O ₃ <i>C. Fares, M. Kneiss, H. von Wenckstern, M. Grundmann, M. J. Tadjer, F. Ren, D. Hays, B. P. Gila, S. J. Pearton</i>	79

Chapter 5

Epitaxial Technologies

(Invited) Al ⁺ Ion Implanted 4H-SiC: Electrical Activation versus Annealing Time <i>R. Nipoti, A. Parisini</i>	91
(Invited) Nanostructures and Crystal Defects in Thick GaN and SiC Epitaxial Layers for Power Electronic Switches <i>A. Christou</i>	99

Chapter 6

Characterization

(Invited) X-Ray Metrology of AlN Single Crystal Substrates <i>R. Dalmau, J. Britt, B. Moody, R. Schlessler</i>	113
Relationship between Basal Plane Dislocation and Local Basal Plane Bending in PVT-Grown 4H-SiC Crystals <i>T. Ailihumaer, B. Raghathamachar, M. Dudley</i>	123

Analysis of Basal Plane Dislocation Dynamics in PVT-Grown 4H-SiC Crystals during High Temperature Treatment 131
B. Raghochamachar, Y. Yang, J. Guo, M. Dudley

Radiation Effects in Diamond pHEMTs 141
A. Thapa, D. Shahin, A. Christou

Chapter 7 Reliability Issues

(Invited) Ag Sinter Joining Technology for Different Metal Interface (Au, Ag, Ni, Cu, Al) in Wide Band Gap Power Modules 147
C. Chen, K. Suganuma

Author Index 155