

---

# **Processing, Materials, and Integration of Damascene and 3D Interconnects**

---

## **Editors:**

### **J. C. Flake**

Louisiana State University  
Baton Rouge, Louisiana, USA

### **P. Ramm**

Fraunhofer IZM  
Munich, Germany

### **H. S. Rathore**

IBM  
Hopewell Junction, New York, USA

### **F. Roozeboom**

Eindhoven University of Technology  
and TNO Science and Industry  
Eindhoven, The Netherlands

### **G. S. Mathad**

S/C Technology Consulting  
Poughkeepsie, New York, USA

### **O. M. Leonte**

Berkeley Polymer Technologies, Inc.  
Hayward, California, USA

## **Sponsoring Division:**



**Dielectric Science & Technology**



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](http://www.electrochem.org)

**ecst**transactions™

**Vol. 25, No. 38**

---

Copyright 2010 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](mailto:ecs@electrochem.org)  
Web: [www.electrochem.org](http://www.electrochem.org)

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

ISBN 978-1-56677-812-1 (PDF)  
ISBN 978-1-60768-162-5 (Softcover)

Printed in the United States of America.

---

## Table of Contents

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

### Chapter 1 Damascene Copper Interconnects

(Invited) Integration Challenges for Copper Damascene Electroplating <i>U. G. Stöckgen, S. Wehner, J. Heinrich, A. Kiesel and R. Liske</i>	3
Chemical Repair of Plasma Damaged Porous Ultra Low-k SiOCH Film using a Vapor Phase Process <i>T. Oszinda, M. Schaller and S. E. Schulz</i>	19
Addition of PEG-Thiol to Cu Electroless Plating Bath for Realizing Perfect Conformal Deposition in Through-Si Via Holes of 3-D Integration <i>F. Inoue, T. Yokoyama, S. Tanaka, K. Yamamoto and S. Shingubara</i>	31
Influence of Carbon Nanotubes on the Electrodeposition of Copper Interconnects <i>T. Chowdhury and J. F. Rohan</i>	37
Effects of Slurry Distribution using Diaphragm and Centrifugal Pumps on the Defectivity in a Cu CMP Process <i>R. Donis, M. Fisher and L. Bauck</i>	47
Effect of Functional Groups of Complexing Agents on the Performance of Cu CMP Slurry <i>Y. Kim, J. Bae and J. Kim</i>	55
Effect of 5-phenyl-1H-tetrazole on Copper Dissolution for e-CMP <i>P. Cojocaru, L. Magagnin and P. L. Cavallotti</i>	65

### Chapter 2 3D Interconnects

Miniaturization of a Wireless Sensor Node by Means of 3D Interconnects <i>J. Prainsack, J. Stolle, J. Weber, M. Dielacher, M. Flatscher, T. Herndl, R. Matischek, P. Ramm and W. Weber</i>	73
---	----

(Invited) 3D Interconnect Technologies for Advanced MEMS/NEMS Applications <i>N. Lietaer, M. Taklo, K. Schjølberg-Henriksen and P. Ramm</i>	87
(Invited) Through-Silicon Via Technology for 3D Applications <i>H. G. Philipsen, O. Lühn, Y. Civale, Y. Wang, D. Sabuncuoglu Tezcan and W. Ruythooren</i>	97
Copper Electrodeposition Parameters Optimization for Through-Silicon Vias Filling <i>E. Delbos, L. Omnès and A. Etcheberry</i>	109
Copper Plating for 3D Interconnects <i>A. Radisic, O. Lühn, J. Vaes, S. Armini, Z. El-Mekki, D. Radisic, W. Ruythooren and P. M. Vereecken</i>	119
High Speed Copper Electrodeposition for Through Silicon Via(TSV) <i>K. Kondo, Y. Suzuki, T. Saito and N. Okamoto</i>	127
(Invited) Reliability of Through Silicon Via Technologies <i>A. Klumpp and P. Ramm</i>	133

**Chapter 3**  
**Poster Session: Processing, Materials, and Integration of Damascene**  
**and 3D Interconnects**

Evaluation of Stability and Reactivity of Solutions by In Situ Transmittance in Electroless Deposition <i>K. Park, H. Koo, T. Lim and J. Kim</i>	145
The Functional Group Effect of Complexing Agent on Cu CMP in the Neutral Environment <i>J. Bae, Y. Kim and J. Kim</i>	155

Author Index	161
--------------	-----