TABLE OF CONTENTS

PREFACE iii
TABLE OF CONTENTS v

SECTION 1: FUNDAMENTALS AND MECHANISMS OF ELECTRODEPOSITION 1

Some Considerations Concerning the Mechanism of Charge-Transfer in Metal Deposition and Dissolution 3
E. Gileadi

Superconformal Electrochemical Deposition of Gold for Interconnects in Integrated Circuits 13
Z. Hu and T. Ritzdorf

Quantifying Competitive Adsorption Dynamics in Superfilling Electrolytes 23
T. P. Moffat, D. Wheeler, and D. Josell

A Comparison Study of MPSA-Cl-PEG and SPS-Cl-PEG Additive Systems for Copper Electrodeposition 34
M. Tan and J. N. Harb

Quantitative Monitoring of Copper Electroplating Additives and Their Breakdown Products 41
M.J. West, M.R. Anderson, Q. Wang, T.H. Bailey, A. Rosenfeld, Z.-W. Sun, and K.P. Ta

Influence of Leveling Agents on Surface Roughness of Electrodeposited Copper Films 57
C. Witt, J. Srinivasan, and R. Carpio

An In Situ Spectroelectrochemical Investigation into the Electrodeposition of Cu from Acidic Sulfate Solutions in the Presence of Poly(ethylene glycol) 67
B. Bozzini, C. Mele, L. D'Urzo, G. Giovannelli, and S. Natali

Surface Roughness Evolution during the Initial Stages of Electroplating for Copper Interconnect Metallization 82
E. Webb, C. Gack, and J. Reid

Impact of Bath Composition on the Purity and Room Temperature Anneal Characteristics of Thin Copper Films 96
J. H. Sukamto and J. D. Reid

Cross-Sectional Crystallographic Analysis of Copper Electrodeposits for ULSI Metallization by EBSD 108
H.-J. Lee, K.H. Oh, and D.N. Lee

Analysis of the Bottom-up Fill during Copper Metallization of Semiconductor Interconnects 117
R. Akolkar and U. Landau

A Case Study in Predictive Three-Dimensional Topography Simulation Based on a Level-Set Algorithm 132
C. Heitzinger, A. Sheikholeslami, J. Fugger, O. Häberlen, M. Leicht, and S. Selberherr

SECTION 2: ELECTROPLATING TOOLS AND PATTERN EFFECTS 143

Advances in Multilevel Interconnect Technology 145
C. E. Uzoh, T. Wang, H. Talieh, and B .M. Basol
Study on the Mechanism of Electrochemical Mechanical Deposition of Copper Layers 155
B. M. Basol, C. E. Uzoh, and T. Wang
Field Effect in "Overplating" Above Damascene Trench Clusters 165
J. O. Dukovic and C. Yu
Leveling of Electroplated Cu in Damascene Applications 184
J. Reid, E. Webb, J. Sukamto, Y. Takada, and T. Archer
Uniform Copper Electroplating on Resistive Substrates 193
R. Fang, K. Namiki, P.M. Vereecken, K.T.Kwietniak, B.C. Baker, K. Ide, H. Suzuki, H. Kanda, K. Mishima, K. Musaka, and H. Deligianni
Unsteady Numerical Simulation of the Mass Transfer within a Reciprocating Paddle Electroplating Cell 205
G. J. Wilson and P.R.. McHugh
Diffusion Boundary Layer Studies in an Industrial Wafer Plating Cell 224
B. Wu, Z. Liu, A. Keigler, and J. Harrell
An Investigation of the Effects of Wafer Curvature Changes During Copper Damascene Processing 235
R.A. Carpio, S.-T.L. Dorris, J. Woodring, D. M.Owen and D. Abisia

SECTION 3: DEPOSITION OF AND ON BARRIERS 249

Formation of Diffusion Barrier Layer on Low-k Material Using Wet Fabrication Process 251
M. Yoshino, T. Yokoshima, T. Osaka, A. Hashimoto, Y. Hagiwara, and I. Sato
Copper Electrodeposition onto Titanium and Other Substrates: Effect of Bath Composition 264
M. Zheng, M. Willey, H. Song, and A.C. West

SECTION 4: CLEANING PROCESSES 273

Fluorocarbon Post-Plasma Etch Residue Cleaning With Naphthalenide Radical Anions 275
C. L.Timmons and D. H. Hess

Etch Rates and Etch Selectivities of p^{++} Doped Si, Undoped Si and Dielectric Films in KOH-Ethylene Glycol-Water Solutions 283
J.S. Starzynski

SECTION 5: PLANARIZATION 295

Copper Electropolishing and Its Application to ULSI Copper Planarization 297
B. Du and I. I. Suni
A Comparative Study of Slurry Flow and Transport in CMP Polishing Pads of Three Groove Arrays 308
G. P. Muldowney and D. P. Tselepidakis
Slurry Backmixing Effects in CMP Rotary and Belt Polishers 318
G. P. Muldowney
Selection of an Oxidant for Copper CMP 327
M. Anik

SECTION 6: MEMS AND MAGNETIC MATERIALS 339

MEMS Fabrication for Wireless Communications Using Copper Interconnect Technology 341
H. Deligianni, J.M. Cotte, C.V. Jahnes, P. Buchwalter, N. Hoivik, M. Krishnan, J. Tornello, J.H. Magerlein, and D.E. Seeger
Magnetically Bistable Actuators for Micro-RF Switch 353
G.D. Gray,and P.A. Kohl
Electrochemically Formed Biaxial Stress Gradients for Improved Electrostatic Actuation 376
G.D. Gray, M.J. Morgan, and P.A. Kohl
PVD Silver as a Material of Choice for Microwave Passives in Silicon Technology 393
V. V. Levenets, R. E. Amaya, N. G. Tarr, and T. J. Smy
Large Volume, High Performance Electroplated Co-Pt(P) Micromagnets for MEMS Applications 404
I. Zana, D. P. Arnold, and M.O. Allen
Two-Dimensional Computational Model for Electrochemical Micromachining with Ultrashort Voltages Pulses 412
J. A. Kenney and G. S. Hwang
Comparison of FECO Films Plated from an Ammonium-Containing Sulfate Bath and from a SBA-Containing Sulfate Bath 420
I. Shao, L.T. Romankiw, E.I. Cooper, C. Bonhote, J. Lam, and H. Xu
Aging of Ni Sulfamate Electrolytes during the Electrodeposition of MEMS Structures 432
J. J. Kelly, S. H. Goods, and A. A. Talin
Fabrication of Hard Magnetic Micro-arrays by Electroless Codeposition for MEMS Actuators 448
S. Guan and B. J. Nelson

CoNi/Cu Multilayers by Electrochemical Deposition 457
J. Zhang, M. Moldovan, D. P.Young, and E. J. Podlaha
Immersion Plating of Bismuth on Tin-Based Alloys to Stabilize Lead-Free Solders 467
E. I. Cooper, C. C.Goldsmith, C. Mojica, S. J. Kilpatrick, and R. J. Alley

AUTHOR INDEX 475

SUBJECT INDEX 477