

## TABLE OF CONTENTS

### A. PFC Emissions Reduction

An Analysis of Fluorinated Compound Emissions Reduction Technologies and Emission Reduction Goals L. Beu and P.T. Brown (Motorola) .....	1
PFC Emissions Reduction and Atomic Fluorine Generation Using C <sub>3</sub> F <sub>8</sub> and Remote CVD Chamber Cleaning Technology L. Zazzera, S. Kesari, W. Reagen, L. Tousignant (3M Company), W. Holber, X. Chen (ASTeX, Inc.) .....	10
Evaluation of C <sub>4</sub> F <sub>8</sub> O as an Alternative Plasma Enhanced Chemical Vapor Deposition Chamber Clean Chemistry L. Pruette, S. Karczki, R. Reif (MIT Microsystems Technology Laboratories), L. Tousignant, W. Reagen, S. Kesari, and L. Zazzera (3M Company) .....	20
Process Optimization and PFC Emission Reduction Using C <sub>3</sub> F <sub>8</sub> Chamber Clean Processes In AMAT P-5000 PECVD Tools S. Kesari, L. Zazzera, L. Tousignant, W.K. Reagen (3M Company), and T. Bach (Rockwell Semiconductor) .....	30
Remote Plasma Clean Technology for Dielectric CVD Chamber Cleaning to Reduce PFC Emissions L. Mendicino, P. T. Brown, S. Filipiak, D. Loop (Motorola), R. Basnett, W. Holber (ASTeX, Inc.), R. Pearce and A. Johnson (Air Products and Chemicals, Inc.) .....	40
Impact of Fluorine from NF <sub>3</sub> Based Chamber Cleaning Processes P.T. Brown, L. Mendicino and V. Vartanian (Motorola) .....	52
Recovery of Perfluorocompounds (PFCs) from Semiconductor Manufacturing Processes Using a Membrane-Based System M. Foder, R. Wimmer, J. Yang (Air Products and Chemicals, Inc.) and T. McCay (Motorola) .....	60
Exhaust Gas Abatement Using ASTRON™ – a Compact, Low-Field Toroidal Plasma Source X. Cheng, W. Holber, R. Basnett, and D. Smith (ASTeX, Inc.) .....	70
Abatement of Greenhouse Gases Using Surface Wave Plasmas B. Wofford, (Rf Environmental Systems), V. Vartanian, L. Beu, T. Lii (Motorola) W. F. Worth (International SEMATECH), C. L. Hartz and J. W. Bevan (Texas A&M University) .....	79
Catalytic Destruction of PFC Emissions from Semiconductor Fabrication Tools A. Bhatnagar T. Kaushal, M. Wong, M. Chafin, K. Ramaswamy, M. Moalem, S. Kats, S Shamoulian (Applied Materials) .....	95

Long-Term Evaluation of a Litmas "Blue" Inductively-Coupled Plasma Device for Point-of-Use PFC and HFC Abatement	
V. Vartanian, L. Beu, T. Stephens (Motorola), R. Jewett (Litmas, Inc.) E. Tonnis and D. Graves (University of California at Berkeley) .....	103
Electrochemical Routes to Perfluorocompound Abatement	
R. Taylor-Smith (Bell Laboratories, Lucent Technologies).....	116
<b>B. Process Emissions Characterization</b>	
Continuous Optical Monitoring of Gaseous Halogens from Tool Effluents	
C. Laush (Radian International), L. Mendicino and P. T. Brown (Motorola) ...	126
Minimizing PFC and HAP Emissions During Ultima HDP-CVD Processing: PSG, USG, and FSG Films	
A. Johnson, R. Pearce (Air Products and Chemicals), M. Waltrip, T. Pham, P. Jennings and J. Branning (Applied Materials) .....	135
Silicon Etch By-Product Measurements Using FTIR Techniques	
J. Cripe, C. D'Acosta, and J. White (Motorola) .....	147
<b>C. Water and Chemical Usage Reduction</b>	
The Environmental and Cost of Ownership Impacts of Two Wet Clean Tools	
P.T. Brown, J. Covington, K. McCormack, J. McDonald, L. Mendicino K. Rhodes (Motorola) and V. Ladigo (Dot-com) .....	156
Ultra Pure Water Recycle Process Development and Simulation	
M. Schmotzer, J. DeGenova, F. Shadman (University of Arizona) .....	169
Motorola Wet Tool UPW Usage Reduction Efforts Using Rinse Resistivity	
K. McCormack (Motorola) and A. Ruiz-Yeomans (University of Arizona) ....	175
Optimization of Ultrapure Water Use for Environmental and Performance Gains in Semiconductor Manufacturing	
R. Chiarello (Stanford University), R. Parker (Hewlett-Packard Company) T. Peterson, K. Romero and D. Seif (University of Arizona) .....	186
Energy Conservation Through Water Usage Reduction in the Semiconductor Industry	
L. Mendicino, K. McCormack, S. Gibson, B. Patton, J.D. Lyon and J. Covington (Motorola) .....	193

## **D. General Technologies**

Degradable Fluorosurfactants in the Semiconductor and Electronics Industries S. Etienne (3M Company) .....	207
Process Compatibility Parameters for Wet Bench Plastic Materials A. Jassal (International SEMATECH) and A. Tewarson (Factory Mutual Research Corporation ) .....	212
Nanoporous SiO <sub>2</sub> /Vycor Membranes for Gas Separation N. Ramanuja, R.A. Levy, E. Ramos and W. Lolertpiphop (New Jersey Institute of Technology) .....	223
Nitrate: Friend or Foe to Granular Iron Remediation? An Electrochemical Characterization of the Nitrate-Iron System K. Ritter, R. Simpraga, R. Gillham (University of Waterloo) .....	234