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Autore	Mägerle Erich W.
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Nota di contenuto	Chemical Mechanical Planarization of Microelectronic Materials; CONTENTS; Preface; 1 Chemical Mechanical Planarization - An Introduction; 1.1 Introduction; 1.2 Applications; 1.3 The CMP Process; 1.4 CMP Tools; 1.5 Process Integration; 1.6 Conclusion and Book Outline; References; 2 Historical Motivations for CMP; 2.1 Advanced Metallization Schemes; 2.1.1 Interconnect Delay Impact on Performance; 2.1.2 Methods of Reducing Interconnect Delay; 2.1.3 Planarity Requirements for Multilevel Metallization; 2.2 Planarization Schemes; 2.2.1 Smoothing and Local Planarization; 2.2.2 Global Planarization 2.3 CMP Planarization2.3.1 Advantages of CMP; 2.3.2 Disadvantages of CMP; 2.3.3 The Challenge of CMP; References; 3 CMP Variables and Manipulations; 3.1 Output Variables; 3.2 Input Variables; References; 4 Mechanical and Electrochemical Concepts for CMP; 4.1 Preston

Equation; 4.2 Fluid Layer Interactions; 4.3 Boundary Layer Interactions; 4.3.1 Fluid Boundary Layer; 4.3.2 Double Layer; 4.3.3 Metal Surface Films; 4.3.4 Mechanical Abrasion; 4.4 Abrasion Modes; 4.4.1 Polishing vs. Grinding; 4.4.2 Hertzian Indentation vs. Fluid-Based Wear; 4.5 The Polishing Pad; 4.5.1 Pad Materials and Properties; 4.5.2 Pad Conditioning; 4.6 Electrochemical Phenomena; 4.6.1 Reduction-Oxidation Reactions; 4.6.2 Pourbaix Diagrams; 4.6.3 Mixed Potential Theory; 4.6.4 Example: Copper CMP in NH₃-Based Slurries; 4.6.5 Example: Copper-Titanium Interaction; 4.7 Role of Chemistry in CMP; 4.8 Abrasives; References; 5 Oxide CMP Processes - Mechanisms and Models; 5.1 The Role of Chemistry in Oxide Polishing; 5.1.1 Glass Polishing Mechanisms; 5.1.2 The Role of Water in Oxide Polishing; 5.1.3 Chemical Interactions Between Abrasive and Oxide Surface; 5.2 Oxide CMP in Practice; 5.2.1 Polish Rate Results; 5.2.2 Planarization Results; 5.2.3 CMP in Manufacturing; 5.2.4 Yield Issues; 5.3 Summary; References; 6 Tungsten and CMP Processes; 6.1 Inlaid Metal Patterning; 6.1.1 RIE Etch Back; 6.1.2 Metal CMP; 6.2 Tungsten CMP; 6.2.1 Surface Passivation Model for Tungsten CMP; 6.2.2 Tungsten CMP Processes; 6.3 Summary; References; 7 Copper CMP; 7.1 Proposed Model for Copper CMP; 7.2 Surface Layer Formation - Planarization; 7.2.1 Formation of Native Surface Films; 7.2.2 Formation of Nonnative Cu-BTA Surface Film; 7.3 Material Dissolution; 7.3.1 Removal of Abraded Material; 7.3.2 Increasing Solubility with Complexing Agent; 7.3.3 Increasing Dissolution Rate with Oxidizing Agents; 7.3.4 Chemical Aspect of the Copper CMP Model; 7.4 Preston Equation; 7.4.1 Preston Coefficient; 7.4.2 Polish Rates; 7.4.3 Comparison of K_p Values; 7.5 Polish-Induced Stress; 7.6 Pattern Geometry Effects; 7.6.1 Dishing and Erosion in Cu/SiO₂ System; 7.6.2 Optimization of Process to Minimize Dishing and Erosion; 7.6.3 Summary; References; 8 CMP of Other Materials and New CMP Applications; 8.1 The Front-End Applications in Silicon IC Fabrication; 8.1.1 Polysilicon CMP for Deep Trench Capacitor Fabrication

Sommario/riassunto

Chemical Mechanical Planarization (CMP) plays an important role in today's microelectronics industry. With its ability to achieve global planarization, its universality (material insensitivity), its applicability to multimaterial surfaces, and its relative cost-effectiveness, CMP is the ideal planarizing medium for the interlayered dielectrics and metal films used in silicon integrated circuit fabrication. But although the past decade has seen unprecedented research and development into CMP, there has been no single-source reference to this rapidly emerging technology-until now.
