

Evolution of Cu PCMP Technology from Mature to Advanced Nodes

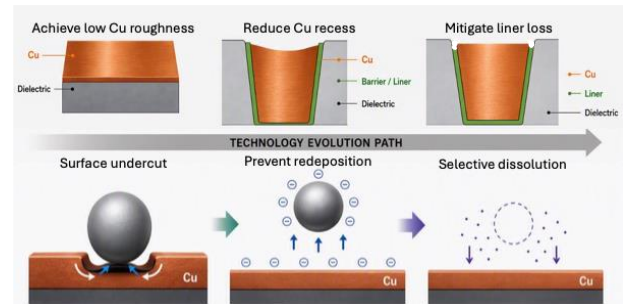
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As semiconductor interconnect technology advances from mature to leading-edge nodes, copper post-chemical mechanical planarization cleaning (Cu PCMP) must meet increasingly stringent requirements for defect removal, metal compatibility, and surface integrity. In mature nodes, Cu PCMP cleaning primarily relied on aggressive undercutting, in which relatively high copper etching promoted the removal of abrasive particles and organic residues. However, continued dimensional scaling, the introduction of cobalt and ruthenium-containing structures, and the increasing sensitivity of low-k materials have substantially narrowed the acceptable cleaning window. These changes require a fundamental transition from aggressive etching toward selective dissolution, controlled surface modification, and effective corrosion inhibition.

This presentation reviews the evolution of Cu PCMP technology, which establishes an integrated Cu PCMP cleaning platform that balances defect removal, corrosion control, and material compatibility, enabling continued interconnect scaling from mature to advanced logic nodes. The presentation also describes how machine learning assisted formulation design, supported by chemistry descriptors and sequential learning, can accelerate candidate selection and identify critical formulation tuning knobs. New evaluation methods strengthen the connection between molecular design, process conditions, and wafer-level performance.



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