Applied Materials Solves Critical Copper Challenges With New Mirra CMP Process

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New Copper CMP Process for the Mirra System Enables
Copper (Cu) Dual Damascene Chip Production

Applied Materials, Inc., the leading supplier of CMP (chemical mechanical polishing) systems to the semiconductor industry, today introduced a production-capable copper CMP process for its Mirra(R) CMP system. The new Mirra Electra(TM) CMP system advances the industry's ability to implement dual damascene copper interconnect technology for high-speed semiconductor chips by enabling high-precision removal and planarization of copper and barrier films.

"As the industry transitions to copper-based chips, one of the most challenging roadblocks has been copper CMP," said Chris Smith, general manager of Applied Materials' CMP Division. "It requires more advanced process capabilities than previous CMP applications because the materials are more difficult to polish, and the result has a greater impact on device performance. Our new copper CMP process takes full advantage of the unique multi-platen architecture of our production-proven Mirra system to provide the process control and productivity that customers need to break through their copper CMP technology barrier."

Applied Materials currently has nine Mirra Electra CMP systems placed at customer sites, with commitments for multiple additional systems worldwide. According to Dataquest, a market research firm, the market for all CMP semiconductor applications is forecast to reach $600 million in 1999 and is expected to grow to $1.5 billion by 2003. Copper CMP is just emerging as a volume application; sales for copper CMP equipment are expected to grow at a compound annual growth rate of 76 percent through the year 2003.

Introduced in 1995, Applied Materials' Mirra CMP tool is the leading system used for planarizing devices at 0.25 micron and below geometries, with approximately 250 systems installed throughout the world. As part of Applied Materials' "Electra" copper product line, the Mirra Cu CMP system joins with the company's Millennia(TM) ECP system, also announced today, and Endura(R) Barrier and Seed system to provide customers with a Total Solutions(R) approach to their copper interconnect manufacturing requirements.

"By working closely with our customers, consumables suppliers and other product groups at Applied Materials, we were able to focus simultaneously on all the process and integration issues that affect the CMP process," said Rob Davenport, global product director of Applied Materials' CMP Division. "This strategy enabled us to develop a process that has been fully optimized for customers' high-volume production requirements."

Copper CMP is the final and key step in the dual damascene copper process flow. After barrier, seed and copper fill layers are deposited in the interconnect structures, CMP is used to remove excess film from the wafer, leaving a smooth, flattened surface for building subsequent circuit layers. The challenge for copper CMP systems has been to achieve the process control necessary to provide uniform wafer planarity with minimal loss of copper in the interconnects for optimum device performance.

"Prior to the Mirra's Electra Cu CMP process, performing copper CMP with acceptable uniformity and repeatability was difficult due to the need to polish different materials (copper and tantalum or tantalum nitride) that have very different polish rates. Any excess copper loss in the polishing process can negate the benefits of using this low-resistance material to achieve faster chip speeds," said Davenport. "The Mirra achieves a new standard for minimizing such process problems as copper dishing and oxide erosion with a range of features that include a multi-platen architecture, Titan Head(TM) polisher and endpoint detection technology."

The Mirra's multi-platen design takes wafers through a sequence of different process steps that polish the wafer with different slurries at different rates as it moves between polishing platens. The system's revolutionary Titan Head(TM) design, introduced in 1997 for oxide polishing, enables a low pressure process that helps minimize dishing and erosion and provides excellent uniformity across the wafer. Since the soft copper fill layer and the hard barrier layer have different removal rates, the ability to polish at very low pressure and conform to wafer variations is a key advantage that contributes to higher device yield.

Also contributing to the system's superior results is Applied Materials' proprietary In Situ Rate Monitor (ISRM(TM)) endpoint technology which allows realtime monitoring of the CMP process. Traditional "timed" processes typically have problems with excessive overpolishing, resulting in unacceptable dishing of the copper interconnect lines. The ISRM accurately identifies the transition between the copper and barrier films to determine the precise point at which to end the process and ensure minimal loss of device features.

Controlling defects is another critical requirement for production-worthy copper CMP. The Mirra Cu CMP process introduces a unique ElectraClean(TM) solution that reduces post-copper CMP defects and resists corrosion. Confirmed in defect performance data collected from equipment and process marathons, the new ElectraClean solution and optimized CMP process minimizes microscratches and demonstrates low, stable defect counts.

Applied Materials is the only company that offers products for all of the key process steps required for dual damascene copper interconnect fabrication. Leveraging this range of technologies, the company also offers the Copper Interconnect Equipment Set Solution(TM) (ESS(TM)).

Launched in late 1998, the Copper Interconnect ESS provides customers with the equipment, integrated process technology and guaranteed electrical results for manufacturing dual damascene structures. The Mirra Electra CMP system is available as a standalone system or as part of the Copper Interconnect ESS.

Applied Materials, Inc. is a Fortune 500 global growth company and the world's largest supplier of wafer fabrication systems and services to the global semiconductor industry. Applied Materials is traded on the Nasdaq National Market System under the symbol "AMAT." Applied Materials' web site is www.appliedmaterials.com.

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