Applied Materials` Unique Integrated Liner/Barrier Solution Hits 100th System Shipment

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Industry's First Integrated PVD/CVD System Helps Chipmakers
Extend Aluminum Interconnects to Smaller Geometries for Higher Speed
Devices

Applied Materials, Inc., the world's leading supplier of metal deposition systems to the semiconductor industry, has shipped its 100th Endura Integrated Liner/Barrier system to Taiwan Semiconductor Manufacturing Co., Ltd. (TSMC) where it will be used to manufacture advanced devices using sub-0.25 micron feature sizes.

The Endura Integrated Liner/Barrier system was announced in December 1996 and features the industry's first integrated PVD (physical vapor deposition) and CVD (chemical vapor deposition) process technologies on a single system. These critical processes are used for depositing robust, conformal titanium/titanium nitride (Ti/TiN) liner/barrier films in tungsten-based contact and via ("plug") structures of advanced metal interconnects. By significantly reducing the resistance of these plug structures, these layers enable the fabrication of high speed microprocessors, logic and memory chips.

"This system's integrated PVD titanium and CVD titanium nitride processes have enabled us to extend our aluminum-based designs to next-generation products and achieve excellent device performance," said Dr. Mark Liu, vice president of TSMC. "The combination of Applied Materials' advanced IMP (ion metal plasma) PVD and CVD technologies on a single system have allowed us to reduce the liner and barrier film thickness for better performance. The system is a manufacturing workhorse that contributes to our profitability and cost-effectiveness."

In little more than two years, the Endura Integrated Liner/Barrier system has rapidly gained an unrivaled position in the marketplace with more than 100 systems shipped to prominent microprocessor, logic, memory and foundry chipmakers in the U.S., Europe, Japan, Korea, Singapore and Taiwan. The system was featured as a Best Product of 1998 by Semiconductor International magazine. Applied Materials' Endura platform, which supports various PVD and integrated applications, has been the industry's global market leader in PVD since the early 1990s and has an installed base approaching 2000 systems.

"Many customers are actively seeking ways to extend today's conventional aluminum-based circuit wiring to 0.13 micron geometries and gigahertz-level speeds," said Dr. Ashok Sinha, president of Applied Materials' Metal Deposition Product Business Group. "TSMC is uniquely positioned to help its customers extend their chip designs through cost-effective aluminum-based interconnect technologies. Applied Materials' excellent relationship with TSMC gives both companies the opportunity to develop ways to optimize this technology for several additional generations of leading-edge products."

To provide an exceptionally thin and conformal liner film layer in the contact and via structures, the system uses Applied Materials' Vectra IMP technology for highly directional deposition of Ti with superior bottom coverage on aggressive aspect ratio structures (greater than 40% bottom coverage for aspect ratios higher than 4:1). Extendible to 0.13-micron designs, this efficient process combines excellent film results with simple and easily maintained hardware to produce very cost-effective Ti films.

The system's CVD process, which operates at a lower temperature than alternative techniques, provides thin (less than 100 angstroms), low resistivity barrier layers. CVD TiN provides excellent conformality, superior step coverage and robust barrier performance to deliver high production yield, enabling advance unlanded via designs, as well as overetched and re-entrant contacts.

"The enabling capabilities of the Endura Integrated Liner/Barrier system have given the industry a production-proven vehicle in the race to more speed and computing power, enabling customers to extend their device performance with an extremely reliable, production-proven system, said Dr. Fusen Chen, vice president and general manager of Applied Materials' Liner/Barrier Division. "We are continuing to enhance our PVD IMP and metal CVD technologies to provide customers with the flexibility and productivity needed for their continued use of aluminum interconnect designs in advanced devices."

By integrating the PVD and CVD processes in an integrated, high-vacuum process sequence, the formation of performance-limiting titanium oxide formation is eliminated. Competing production technologies require multiple mainframes and a vacuum break during the process sequence, resulting in higher resistance, lower throughput, more process steps and a higher cost of ownership. At the same time, the Endura system's low processing temperatures enable significantly easier integration with various low dielectric constant (low k) materials. The adoption of low k dielectrics is expected to allow chipmakers to further reduce device density while significantly boosting operating speed and lowering power requirements.

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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