Applied Materials sets cobalt on path to future chips

May 15 2014, by Nancy Owano

When a global leader in providing equipment, services and software used for manufacturing semiconductors makes an announcement, industry players sit up and listen, as the technologies are going to impact market activity in devices such as smartphones, flat screen TVs and solar panels. Tuesday's announcement from Applied Materials was big. The Santa Clara, California based equipment supplier announced the launch of its

Endura Volta CVD Cobalt chip making machine. This is the only tool capable of encapsulating copper interconnects in logic chips beyond the 28nm node by depositing precise, thin cobalt films, said the company. The news is in the word "cobalt." The company sees cobalt as a superior metal encapsulation film. "Applied Materials announced that the Endura Volta CVD Cobalt system represents the first material change in more than 15 years of copper barrier/seed (CuBS) development, "a new materials era" for extending copper interconnect technology. It is not only the first material change but an important change in materials for microchip wiring. Actually, the news is in the word "cobalt" and in the word "wiring."

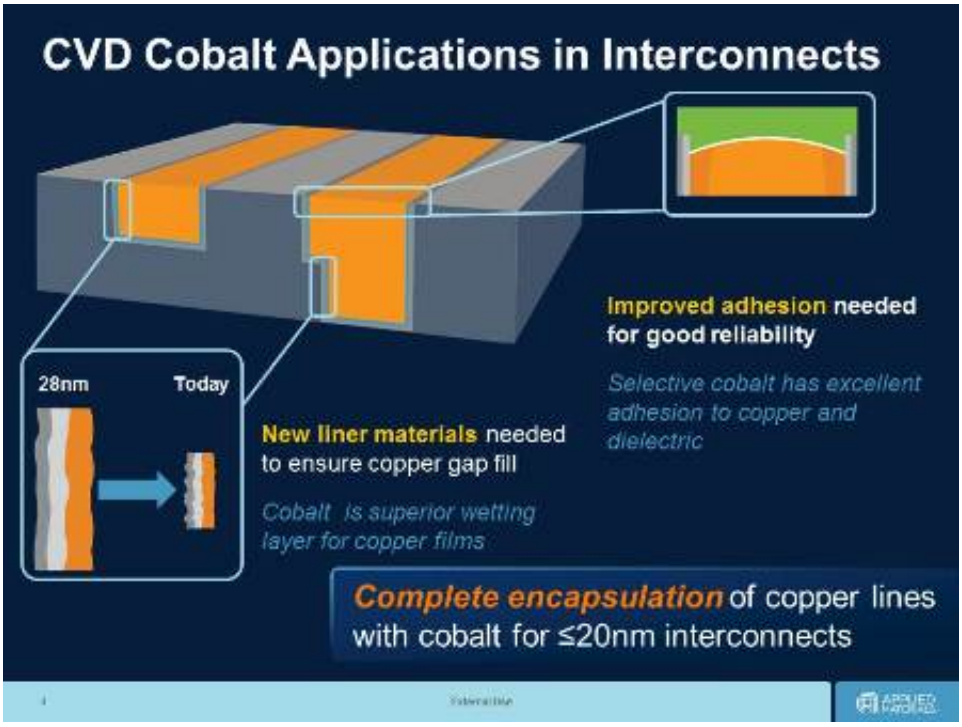
The reliability and performance of the wiring that connects the billions of transistors in a chip is critical to achieve high yields for device manufacturers. "As wire dimensions shrink to keep pace with Moore's Law, interconnects are more prone to killer voids and electromigration failures," said Dr. Randhir Thakur, executive vice president and general manager of the Silicon Systems Group at Applied Materials.

Writing in the Applied Materials blog, Kavita Shah, global product manager, commented on the announcement: With today's dimensions, she said, "it becomes exceptionally difficult to achieve perfect copper fill in 100% of the trenches and vias that make up the circuitry of a device. Other performance-degrading effects, such as electro-migration, which can cause movement of copper that leaves voids in the wiring, also become significantly more problematic. The smallest defect can kill a device; interconnect performance and reliability begin to suffer under these conditions."

The announcement said that complete envelopment of copper lines with cobalt creates an engineered interface that demonstrates over 80x improvement in device reliability.

Writing in *The Wall Street Journal*, Don Clark said the company has announced a way "to head off defects that are becoming a stumbling block as manufacturers keep shrinking the size of transistors that act as tiny switches on chips." Customers who want to make the shift will buy the production machine to apply the cobalt, using a process called chemical vapor deposition (CVD).

According to the article, Sundar Ramamurthy, Applied's vice president and general manager of metal deposition products. said 75 of the CVD chambers for processing individual wafers are already in customer hands for testing purposes. Clark said, "The machines aren't likely to be introduced in large volumes "until manufacturers are ready for their next process change to create smaller transistors."



The new system announced Tuesday gives Applied Materials an advantage in touting expertise in precision materials engineering to alleviate roadblocks. The system involves two enabling applications, a conformal cobalt liner and a selective cobalt capping layer. They provide complete enclosure of the copper lines, which, the company said, improves reliability "by an order of magnitude."

Shah wrote, "What Applied Materials has done by enabling the two new process steps—the Volta CVD system's cobalt liner and selective cobalt capping layer—is to demonstrate improved copper gap fill and an order-of-magnitude reduction in electro-migration." Shah said cobalt was a phenomenal new material. "It offers low resistivity and adheres well to copper and barrier layers."

More information: blog.appliedmaterials.com/new-materials-era www.appliedmaterials.com/produ … ura-volta-cvd-cobalt

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