Higher dose sensitivity progress in novel photoresist platforms

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SEMATECH announced today that researchers have reported progress which could significantly improve resist sensitivity by incorporating metal oxide nanoparticles for extreme ultraviolet (EUV) lithography, bringing the technology another step toward enabling the development of high performance resists required to enable EUV for high-volume manufacturing (HVM).

SEMATECH engineers, in association with scientists from Cornell University, have demonstrated significantly higher dose sensitivity by incorporating metal oxide nanoparticles, with a resolution dose that is less than one fifth of that normally used with EUV scanner throughput calculations. These significant advances are critical in moving forward the infrastructure that will prepare EUV lithography for HVM at 20 nm half-pitch.

"These resist platforms have the potential to significantly relax the EUV source power requirements to enable high-throughput EUV lithography—which has been the most critical barrier to enabling EUV to enter high-volume manufacturing," said Michael Lercel, SEMATECH's senior director of Technology. "With these disruptive photoresist platforms, SEMATECH is working toward enabling breakthrough high performance resists that move forward the infrastructure that will prepare EUV for cost-effective manufacturing."

Despite strong progress in EUV lithography over the past decade, significant challenges remain. This includes the development of an ultra

high-resolution photoresist—a light-sensitive material used to form a patterned coating—that simultaneously supports the combined requirements of low line-edge roughness (LER), high sensitivity and resolution for nodes where EUV will be introduced.

EUV source power progress has been slower than desired and remains lower than the specification for HVM. Source power has been reported by ASML at 55 watts, which would enable wafer throughput of approximately 40 wafers-per-hour. However, since source power requirements are approximately linear with resist sensitivity, in order to achieve throughputs consistent with HVM, industry source power roadmaps have been calling for 250 watts or more, based on the assumption that a resist sensitivity of 15 mJ/cm2 is required. Metal oxide nanoparticle resists have demonstrated imaging results at 20 nm resolution with less than 2 mJ/cm2 dose requirements.

"Nanoparticle resists demonstrated one order of magnitude higher sensitivity of that to imaging the same line/space patterns in conventional EUV resists, which helps mitigate the source power issue," said Chandra Sarma, advanced material development project manager at SEMATECH. "Through sophisticated process capabilities, the goal of our work is to find an alternate resist system that has low line edge roughness, good resolution and high dose sensitivity. All these parameters are important from the view point of inserting EUV in high-volume manufacturing."

Provided by SEMATECH