

Researchers achieve breakthrough defect reductions in EUV mask blanks

May 7 2014, by Erica McGill

SEMATECH announced today that researchers have reached a significant milestone in reducing tool-generated defects from the multi-layer deposition of mask blanks used for extreme ultraviolet (EUV) lithography, pushing the technology another significant step toward readiness for high-volume manufacturing (HVM).

Following a four-year effort to improve deposition tool hardware, process parameters and substrate cleaning techniques, technologists at SEMATECH have, for the first time, deposited EUV multilayers with zero defects per mask at 100 nm sensitivity (SiO_2 equivalent). Eliminating these large "killer" defects is essential for the use of EUV in early product development. These results were achieved on a 40 bi-layer Si/Mo film stack and measured over the entire mask blank quality area of $132 \times 132 \text{ mm}^2$.

In addition, by subtracting out incoming substrate defects, SEMATECH has demonstrated that the multilayer deposition process itself can achieve zero defects down to 50 nm sensitivity. Coupled with novel improvements to the mask substrate cleaning process to remove incoming defects, this represents the capability to both extend EUV to future nodes by eliminating smaller "killer" defects, and as a step to reducing smaller defects (which can be mitigated) to a level where improved yield and mask cost make EUV a more cost-effective HVM technology.

"SEMATECH's comprehensive programs continue to produce the results

that our members and the industry need to show that EUV lithography is manufacturable," said Kevin Cummings, SEMATECH's Lithography manager. "Our Advanced Mask Development program continues to demonstrate practical results for mask blank defect reduction, more efficient deposition and cleaning, effective reticle handling, and other areas that the industry will need for successful EUV lithography manufacturing."

Defects are generally created by the deposition process or formed by decoration of substrate defects during the multilayer [deposition process](#). These types of defects have prevented the quality of mask blanks from keeping pace with roadmap requirements for the production of pilot line and high-volume manufacturing EUV reticles. Reducing [defects](#) in the EUV mask blank multilayer deposition system is one of the most critical technology gaps the industry needs to address to enable cost-effective insertion of this technology at the 16 nm half-pitch.

"A low defect density reflective mask blank is considered to be one of the top two critical technology gaps for the commercialization of EUV," said Frank Goodwin, manager of SEMATECH's Advanced Mask Development program. "Through sophisticated defect analysis capabilities and processes, the goal of our work is to enable model-based prediction and data-driven analysis of defect performance for process improvement and component learning. We then use these models to feed into the new deposition tool design."

Provided by SEMATECH

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