The SEMATECH Berkeley MET: Bridging the gap to 16-nm half pitch development

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Microfield exposure tools (METs) play a crucial role in the development of extreme ultraviolet (UV) resists and masks. One of these tools is the SEMATECH Berkeley 0.3 numerical aperture (NA) MET. Using conventional illumination, this tool is limited to approximately 22-nm half pitch resolution. However, using a method would prefer to as pseudo phase-shift mask we can mitigate both optic and mask limits to resolution. We demonstrate the use of this method for the characterization of a variety of resists with and without chemical amplification. Patterning capabilities down to have pitches of 18 nm and below are shown with this method. The highest resolution was achieved in a new image of ball hard mask which also supports contact printing down to 22 nm with conventional illumination. Along with resolution, line-edge roughness is another crucial hurdle facing EUV resists. It has recently been shown that the mask can be a significant contributor to LER. We show that a new generation EUV masks with 100 pm of substrate roughness can achieve correlated LER values of 1.1 nm, which represents a 3x improvement over the correlated LER of her older generation EUV masks having a substrate roughness of 230 pm. Finally we will discuss the capabilities of a proposed 0.5-NA MET that would address the needs of EUV development and 16-nm node and beyond. The tool will support an ultimate resolution of 8 nm half-pitch and generalize printing using conventional illumination down to 12 nm half pitch. This work was performed Lawrence National Laboratory. And supported by SEMATECH.

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