Actinic inspection of multilayer defects on EUV masks

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ABSTRACT

The production of defect-free mask blanks remains a key challenge for EUV lithography. The development of techniques to reliably and accurately detect defects on un-patterned mask blanks is an essential aspect of ensuring a reliable supply of defect-free mask blanks. Mask-blank inspection tools must be able to accurately detect all critical defects whilst simultaneously having the minimum possible false-positive detection rate.

We have recently deployed a unique dual-mode (high-speed scanning and at-wavelength microscope) EUV mask inspection system on a bending-magnet beamline at the Advanced Light Source (ALS) synchrotron at Lawrence Berkeley National Laboratory. With data acquired during the commissioning phase, we present cross-correlation results comparing actinic defect inspection over large areas of un-patterned mask blanks with the results of non-actinic inspection using a commercial EUV mask blank inspection tool. Anticipating that non-actinic tools can and will be used by industry to qualify EUV mask blanks, the study and validation of non-actinic inspection techniques remains a high-priority area of research. Are non-actinic tools *capable* of detecting all printable EUV defects?

In its high-speed inspection mode, whole mask blanks are scanned for defects using a focused beam of 13.5-nm-wavelength light to identify and map points of significant light scattering or reflectivity change. In imaging or *defect review* mode, a zone-plate lens placed in the reflected beam path images a small region onto a CCD detector with an effective resolution on the mask of 100-nm, or better. Combining the capabilities of these two inspection modes in one system provides a unique opportunity to compare actinic with visible-light defect responses, and to qualify inspection tools now under commercial development. The predictions of EUV scattering models can also be evaluated with data gathered in this tool.

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