Scanning coherent diffraction imaging techniques for EUV photomask metrology

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Extreme ultraviolet (EUV) lithography at 13.5 nm wavelength is currently considered as the most promising alternative to DUV immersion lithography for high-volume semiconductor manufacturing at technology nodes below 10 nm. One of the challenges of EUV lithography is the metrology of photomasks. On EUV masks, locating, i.e. mask inspection, and characterizing the defects, i.e. mask review, are crucial issues that need to be solved for the successful introduction of EUV lithography into the high-volume manufacturing phase.

We use lensless imaging, i.e. scanning coherent diffraction imaging methods, in order to image surfaces in the reflection mode. In these techniques, diffracted light from the sample is measured while the sample is scanned across a coherent illumination. Redundant scattering information from the sample is collected and the image of the sample is reconstructed via iterative computational calculations to a resolution much smaller than the illuminating beam size. This method enables fast reconstruction of amplitude and phase response of samples without limitations of optics. One immediate application of this method is photomask metrology. This method can provide a cost-effective and high-throughput solution to this challenge.