EUV coherent scattering for wafer metrology

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EUV lithography is the leading technique in semiconductor manufacturing, owing to its short wavelength, which enables high-resolution patterning for future technology nodes. Nonetheless, the ambitions towards further device downscaling face significant challenges especially in metrology. To address these challenges, we developed a novel wafer metrology tool capable of non-destructive measurements on wafers at the nanoscale using EUV coherent scattering in reflection mode. EUV light not only facilitates the production of smaller features in lithography but also emerges as a powerful approach for the metrology required to characterize and analyze these intricate features in future technology nodes, thanks to its short wavelength, relevant penetration depth, and high reflectivity with relatively high grazing angles compared to that of X-rays. Our synchrotron-based tool, REGINE, installed at the Swiss Light Source, operates in the extreme ultraviolet (EUV) and soft X-ray regions with a wavelength range of 6 to 16 nm in the grazing-incidence reflection mode. It uses an ellipsoidal mirror to focus the illumination beam from the synchrotron onto the sample surface, while the angle of incidence is tunable from 1 to 28 degrees (grazing). The tool is used for reflectometry for precise analysis of thin films and multilayers, for scatterometry to probe periodic structures and perform overlay metrology, and for coherent diffraction imaging (CDI) to perform microscopy of layered samples to reconstruct the 2D and 3D profile of nanostructures. In this work, we will present the REGINE system and the newest experimental results of patterned wafer metrology accommodating various structures and materials.