Evaluation of a laboratory-based EUV scatterometer for nanoscale grating characterization

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Optical measurement techniques, such as light scattering, are employed for rapid and non-destructive assessment of periodic semiconductor structures in industrial production lines. As the sizes of these structures continue to decrease and already reach the nanometer scale, a viable approach to resolve finer structural features is to reduce the probing radiation's wavelength. Extreme ultraviolet (EUV) radiation is proposed for application in optical critical dimension (OCD) metrology for the future semiconductor industry.

Consequently, scalable laboratory-based EUV scatterometers that utilize available compact EUV radiation sources are of significant interest for characterizing modern semiconductor structures. A recent presentation introduced a prototype of such a setup, employing discharge-produced plasma as an EUV source, which could also be integrated into the industrial production line [1]. To determine the effectiveness of this setup in accurately characterizing periodic nanostructures, such as line gratings, the authors conducted a comparative study [2].

The EUV beamline scatterometer of the PTB at the synchrotron facility BESSY II was utilized to replicate the scatterometry measurements as a reference, employing the same sample. Markov chain Monte Carlo (MCMC) sampling generated solutions along with their associated uncertainties regarding the shape of the grating sample, based on a model applied to measurement data from both setups.

Comparing the reconstructed grating dimensions from laboratory-based and synchrotron-based measurements, along with their uncertainties, enables a direct assessment of the characterization accuracy of both setups.

[1] L. Bahrenberg, S. Danylyuk, S. Glabisch, et al., 2020, Opt. Express **28(14)**, 20489-20502.

[2] L. M. Lohr, R. Ciesielski, S. Glabisch, et al., 2023, Appl. Opt. **62(1)**, 117-132.