Diffraction grating characterization with grazing incidence EUV scattering

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The laboratory EUV scatterometer developed at RWTH Aachen University is a table-top experimental metrology tool for accessing form and roughness of structured periodical and aperiodical surfaces on the micro- and nanometer scale (Fig. 1 left). The compact setup consists of a discharge produced plasma (DPP) EUV source operated with xenon gas, spectrally filtered with two multilayers to 13.5 nm (2 % bandwidth), a sample positioning module and an in-vacuum CCD camera for measurement of diffraction orders.

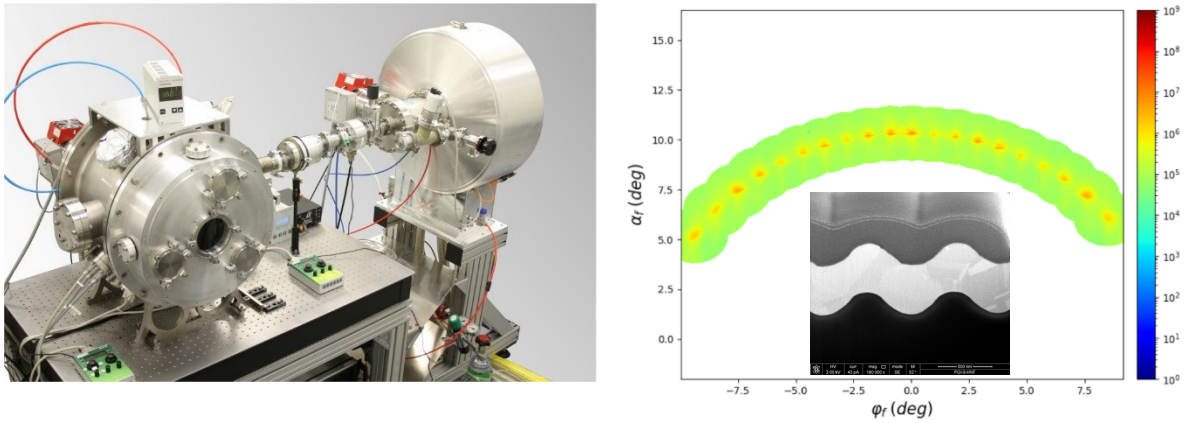

Fig. 1 *Left: Laboratory EUV scatterometer. Right: EUV diffraction pattern measured in conical geometry at a grazing incidence angle of 10.7 degree. Inset: Cross-sectional scanning electron micrograph of the sinusoidal test grating.*

Standard gold-plated sinusoidal holographic diffraction grating with period of 833 nm and a line depth of 250 nm is investigated under grazing incidence illumination in both, standard (in-plane) and conical (off-plane) illumination geometry. Resulted experimental diffraction patterns (Fig. 1, right) are compared with several analytical models simulated in BornAgain software package [1], developed at Jülich Centre for Neutron Science (JCNS). The simulations are in good agreement with experimental results, allowing reconstruction of illumination geometry and extraction of grating parameters almost in live-mode. The simulation of an absolute intensity distribution within the diffraction orders however, found to be extremely sensitive to the grating parameters such as depth and line shape. Simulations using different analytical models and the progress in fitting of grating parameters to the experimental data will be discussed.

[1] J. Burle et al, *BornAgain - Software for simulating and fitting X-ray and neutron small-angle scattering at grazing incidence*, version 1.15 (2019). Available at: http://www.bornagainproject.org