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The footprint from distinctly rough gratings in the scattering pattern

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For the control of the lithographic manufacturing process, a rapid in-line metrology is needed. New metrology solutions may accomplish the characterization of more complex 3D structures, where the effect of the roughness becomes even more acute. Grazing incidence small angle X-ray scattering (GISAXS) is a reliable technique with high surface-sensitiveness which allows short acquisition times. However, the footprints obtained are much larger than the structured area. We counteract this disadvantage by using larger incidence wavelengths in the EUV-photon energy range, which allows larger incidence angle without compromising the surface sensitiveness, for the investigation of rough lamellar gratings.
We investigate the contributions due to the roughness to the scattered pattern. Therefore a set of gratings was designed with a controlled roughness. Two different types of roughness are distinguished: line edge roughness (LER), where the center position changes along the line and line width roughness (LWR), where the width of the line changes and different types of roughness distribution: periodic, chirped or stochastic. Each type of roughness leads to a different scattering pattern, which opens new perspectives for the unequivocal characterization of such structures by EUV-scatterometry.

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