

Adapted Technologies for Customized EUV-gratings

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A grating manufacturing technique must maintain the initial high-quality surface figure of the polished grating blank. Simultaneously the generation of very smooth grating facets is required to yield both, high diffraction efficiency and minimum stray light levels. Due to the thermal and mechanical constraints the substrates of EUV- or synchrotron gratings are typically comparable heavy and show extended physical dimensions. Additionally, various applications involve curved gratings and/or defined variable lines and spaces (VLS) grating types. These demanding requirements limit the spectrum of manufacturing technologies to mechanical ruling and – in our view most adequate - interference lithography.

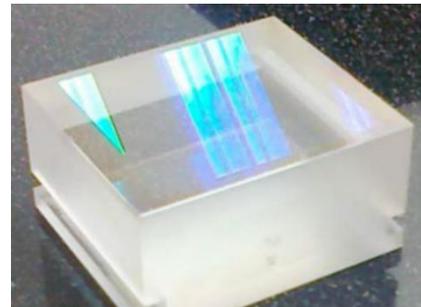


Fig. 1. Cylindrical blazed EUV grating etched in fused silica prior to the coating step (80x70x40mm³)

Based on interference lithography at ZEISS, there are several technologies that lead to optimal grating structures:

- a) the down-scaling transfer process from direct blazing in photoresist - resulting in a reduction of the roughness value of the resist grating equivalent to the scaling factor (example Fig.1) [1], [2]
- b) anisotropic wet etching of monocrystalline silicon with a defined tilt of the <111>-crystal planes relative to the substrate surface for achieving well controlled blaze facets [3], [4]
- c) physical etching of quasi binary resist gratings for laminar gratings [5]

All these methods offer the potential for additional optical functions of the grating based on a defined curvature of the substrate – up to a freeform option. Further, aberration corrections or imaging functions – resulting in a reduction of the number of elements in a monochromator setup - can be achieved by VLS-gratings in general. The accessible enhanced wave front measurement techniques enable the test of complex grating structures as well. A special stitching interferometer setup can be utilized to capture a certain part of the gratings diffraction order(s) and refer it to a defined target interference pattern.

References

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