Holographic gratings for EUV and VUV application

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Nowadays VUV and EUV metrology applications frequently require customized diffraction gratings with very demanding specifications, particularly in terms of surface microroughness and diffracted wavefront. In that context, holographic gratings, prepared by carefully interfering two coherent waves, have some distinct advantages over classical grating ruling. First, as all grooves are placed at once in a deterministic fashion, there is a vanishing in-plane scatter as compared to ruled gratings. Second, holographic gratings exhibit excellent diffracted wavefronts even for VLS-type groove distributions, undisturbed by statistical or periodic groove placement errors. Lastly, holography can be performed on any surface figures, ranging from plane over spherical to cylindrical for freeform surfaces. As an additional feature holographic recording may introduce intentionally curved grooves that enable, e.g., the reduction of aberrations in imaging applications.

Over decades the company ZEISS has mastered holographic grating manufacturing. Moreover, ZEISS is able to manufacture large grating substrates with challenging surface qualities (microroughness < 0.3 nm, figure errors in the nrad regime). This noteworthy combination of technological capabilities enables ZEISS to offer customized EUV / VUV gratings of unsurpassed quality from a single source.

In our talk, we discuss the strong advantages, but also the technological limits, challenges, and constraints of holographic grating recording. We demonstrate how monolithic, blazed EUV / VUV gratings can be achieved using our “direct blaze” approach. Further, based on our experiences with the manufacturing of these grating types we try to estimate the “soft” and “hard” limits of grating parameters that can be achieved. Finally, we will demonstrate the principle of recording customized VLS groove distributions using customized holographic setups and special recording optics.