Fabrication of x-ray gratings by direct write mask-less lithography

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ABSTRACT

Fabrication of diffraction grating for x-rays is a very challenging problem due to the exacting requirements of surface quality and groove profile. Traditional fabrication techniques have significant limitations and do not cover all necessary requirements. For example, classical holographic recording is limited in the type of groove patterns that can be produced. This is particularly important in the design of wide aperture high resolution spectrometers, where aberration correction using complex groove patterns is necessary. Traditional interference lithography and ruling methods are also limited in their ability to produce shallow blazed gratings with maximal efficiency. Here we will show how two new technologies are having an impact in this area and potentially will revolutionize grating performance. We are pioneering the use of direct-write mask-less lithography to make grating patterns of arbitrary complexity, together with the use of anisotropic etching of silicon to produce near atomically perfect groove shapes.
In this work we report on the first results from our direct-write mask-less approach, including quality assessment of the patterns using interferometric techniques, as well as new results on shallow blaze angle anisotropically etched silicon grating. This work was supported by the US Department of Energy under contract number DE-AC02-05CH11231.

Key words: diffraction grating, x-rays, mask-less lithography, optical metrology, AFM, diffraction efficiency.

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