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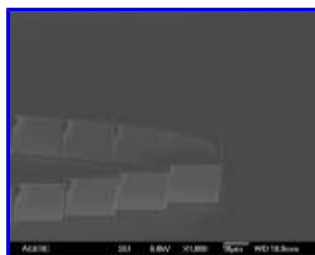
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Single element kinoform hard x-ray micro-optic

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A Fresnel lens is a chromatic, but low-loss optic, that can be used as a hard x-ray focussing element. In order to maintain phase coherence across the lens for a given x-ray wavelength, and to maximize transmission, material is deleted that removes multiples of 2π phase-shift. Using planar micro-electronics technology we have fabricated refractive Fresnel lenses for hard X-rays in single crystal silicon, and with the ideal shape. An x-ray focusing Fresnel lens is shown in the Figure. The lens profile is transferred to a resist coating of UV113, using a JEOL electron beam writer (JBX-9300FS). The resist profile is subsequently transferred to a 500 nm thick oxide hard mask, using an AMAT 5200 magnetically enhanced reactive ion etching tool, with an EMAX plasma source. Finally, using an Advanced Silicon Etcher from STS, the oxide profile is etched 40 microns deep into the silicon substrate. Using a knife edge fabricated from a lithographically defined 500nm thick copper film, we have measured the properties of these lenses at 12.4 keV, by scanning the film across the focussed X-ray beam, and detecting the copper fluorescence.

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