Hard X-ray Kinoform Lenses

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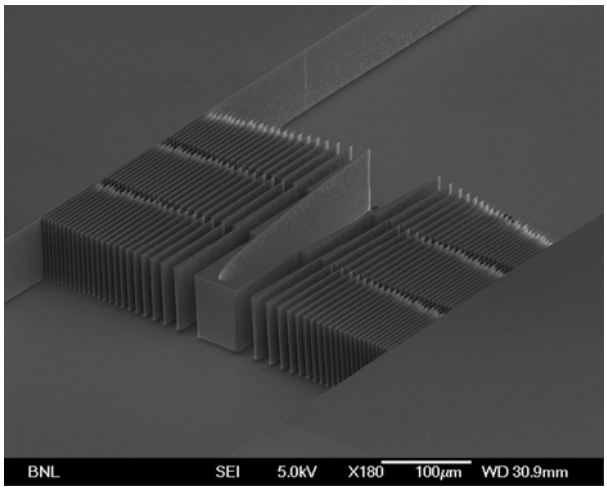
Research Achievement

Using micro-fabrication facilities at the CFN, BNL, we have fabricated and successfully tested low-loss kinoform lenses for hard X-rays photon energies as low as 7.3keV, and energies as high as 30keV. Focusing hard x-ray photons is technically challenging due to the relatively low values for the real part of the refractive index, and relatively large imaginary or absorptive part of the refractive index. Kinoform lenses are a relatively recent addition to the limited set of focusing options for hard X-rays. There has been steady progress in the quality of hard x-ray focusing optics, and this, in conjunction with brighter synchrotron sources, has enabled spot sizes as small as 100nm and below. These focusing optics enable one to perform spatially resolved versions of widely used characterization techniques such as x-ray diffraction, EXAFS, and other x-ray spectroscopies. Kinoform lenses have lower absorption and larger apertures, than the equivalent refractive-limit lens. We present measurements and simulations of the effectiveness of kinoform lenses. Additionally, using the same micro-fabrication techniques, we have also fabricated low loss Fresnel prisms for hard X-rays. The prism and lens are two of the fundamental building blocks for more complicated optical systems and combinations of these two optical elements should result in interesting and useful high resolution synchrotron based



applications, for example phase contrast imaging.

Future Work

Our near term goals are fabricating lenses with diffraction limited resolutions in the 20nm to 50nm range. We are also deploying the lenses in more difficult situations, such as existing bending magnet beamlines with imperfect optics already in place. These bending magnet applications require optics with larger apertures.

References

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