Nanometer Focusing using Diffractive X-ray Optics

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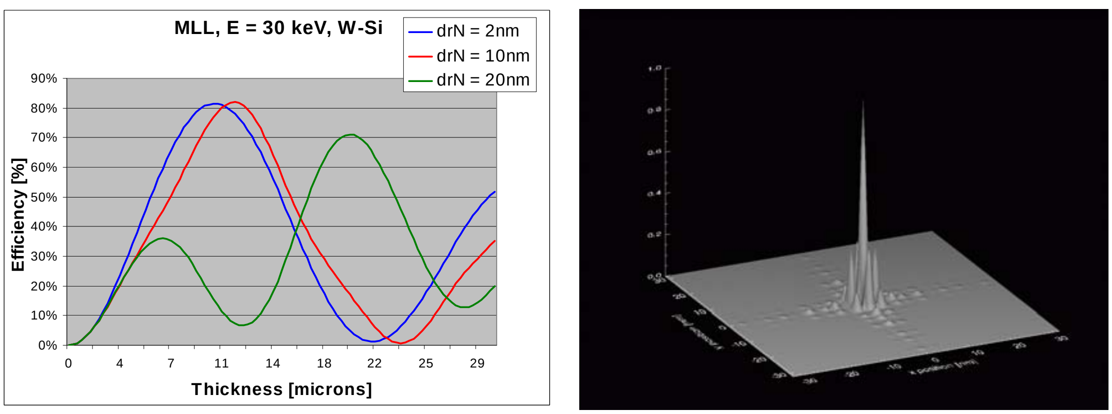
Significant attention has been paid recently to the spatial resolution that can be achieved with x-ray optics. While it is widely accepted that a spatial resolution approaching 10 nm is possible using both far-field optics and near-field optics, the feasibility of focusing below 10 nm has only recently begun to be explored.[1,2]

We will discuss the focusing properties of diffractive optics designed to achieve a spatial resolution below 10 nm. The diffraction properties of these optics are characterized by dynamic diffraction effects.[3] This results in diffraction efficiencies well above 40% for the diffraction order used for focusing, and to correspondingly small efficiencies for all other diffraction orders. Dynamic effects also lead to radial changes of the phase of the diffracted wave, which will change the focal length and cause spherical aberrations. Increased sensitivity to deviations from the Bragg condition with increasing numerical aperture requires tilting of the zones with respect to the optical axis, and limits the energy range for which high-resolution diffractive optics can be used.

A technical concept for achieving sub-10 nm focusing is the Multilayer Laue Lens.[4,5] An MLL consists of two crossed linear zone plates fabricated by deposition of a graded multilayer on a plane substrate. The diffraction and focusing properties of this system will be presented.



A) Efficiency of a high-resolution diffractive optic as function of zone width
B) Point spread function of a Multilayer Laue Lens

References

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