SAGITTAL FOCUSING OF HIGH-ENERGY X-RAYS

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The availability of high-energy x-rays with large horizontal divergence (of the order of 5 milli-radians) at the bending magnet of the newer synchrotron radiation facilities such as the APS, and the wiggler beamlines at lower energy facilities such as NSLS, calls for effective and easy-to-implement focusing and monochromatizing optics. Traditional horizontal focusing methods, using mirrors or sagittal-focusing Bragg crystals, were limited at high x-rays energies, due to the large foot-print of the beam at these energies and the limited numerical aperture of mirrors. Curved multi-layer optics are promising if technical challenges can be met.

Sagittal focusing and monochromatization of high-energy synchrotron x-rays with asymmetric Laue crystals is proposed and demonstrated. At high x-ray energies, this is preferred because of the small extent of the beam's footprint on such a crystal, and the ability to take advantage of the anticlastic-bending by using the inverse-Cauchois geometry in the meridional plane to improve energy resolution. Reflectivity curves of sagittally-bent Laue crystals were measured, on planar crystal wafers, bent by a four-bar bender, at x-rays energies from 15 to 70 keV. A model for the diffraction properties of sagittally bent Laue crystals, which takes into account the anisotropy in the elastic property of the crystals, was developed. The widths of the rocking curves, calculated using the analytical model, were compared with measurements on crystals of two different orientations, (111) and (100). Results of depth-resolved rocking-curve measurements are presented and discussed.

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