Large aperture prism-array lens for high energy X-ray focusing

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A new prism-array lens (PL) for high energy X-ray focusing is constructed by an array of different prisms obtained from different parabolic structures by removing passive parts of materials leading to a multiple of 2π phase variation, shown in Fig.1.

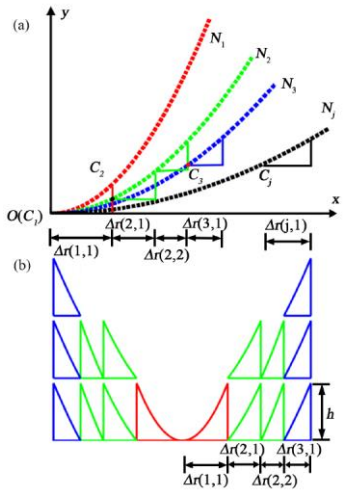

Fig. 1 The derivation of a PL from different parabolic profiles. The tooth-like segments with the same colour are obtained from the same parabolic profiles.

Under the thin-lens approximation the phase changes caused by this lens for a plane wave are exactly the same as those caused by a parabolic lens without any additional corrections when they have the same focal length, which will provides good focusing; at the same time, the total transmission and effective aperture of this lens are both larger than those of a compound kinoform lens with the same focal length, geometrical aperture and feature size. This geometry can have large aperture not limited by the feature size of the lens.

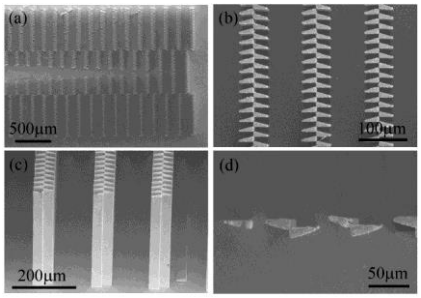

Fig. 2 SEM image of the PL produced by LIGA technology.

Prototype nickel lenses with the aperture of 1.77mm and the focal length of 3m were fabricated by LIGA technology (shown in Fig.2), and were tested using CCD camera and knife-edge scan method at X-ray Imaging and Biomedical Application Beamline BL13W1 in Shanghai Synchrotron Radiation Facility, which provided the focal width of 7.7μm and a photon flux gain of 14 at an X-ray energy of 50keV (shown in Fig. 3).

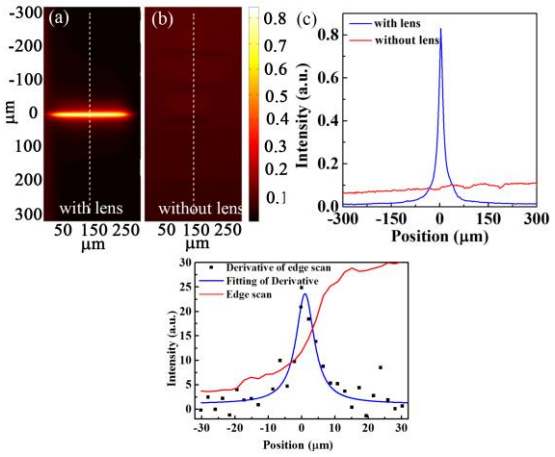

Fig. 3 Images with (a) and without (b) lens in the focal plane captured by a CCD camera; (c) The intensity profiles of the focused X-ray beam; (d) Intensity profile in the focal plane measured with knife-edge scan.