Multilayer Laue Lenses (MLL) are a promising approach based on diffraction to focusing hard x-rays and promise to open the path to nanometer spot sizes [1]. Limitations implied by the fabrication process of zone plates regarding possible zone widths and aspect ratios are circumvented. Using thin film deposition techniques alternating zones of two different materials are deposited onto a flat substrate with thicknesses according to the zone plate law. A lamella then cut out of the coating using Focused Ion Beam milling. This segment is the actual lens and produces a focal line. Combined with a second perpendicularly aligned lens a point focal is achieved. The structures accommodating the lenses are glue-bonded directly onto each other. The distance between the lenses is approximately 30 µm (fig. 1). The pair of lenses is then fixed onto a single mount. Only two precise tilting stages are necessary as well as two stages for coarse position alignment. At the ESRF beamline ID13 and the PETRA III beamline P06 we have shown such setups of pairs of crossed MLLs. The lenses were characterized using Ptychography [2]. According to the reconstructions of the complex wave field focal spots with a FWHM of about 50 x 50 nm^2 and less have been achieved. In addition the local diffraction efficiency of a wedged MLL was compared to a regular tilted geometry lens. The results show an increase of intensity in the first focusing order of more than 30%. Particularly the local diffraction efficiency of the zones with less than 10 nm zone width increased noticeably.

References

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Fig. 1: Process photograph of the Magnetron Sputter Deposition.

Fig. 2: SEM image of a pair of crossed MLL with a distance of approximately 30 µm.