Efficient sub-25 nm focusing and advanced measurement methods using crossed Multilayer Laue Lenses

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Calculations have shown the potential of Multilayer Laue Lenses (MLLs) to achieve resolutions in the sub 5 nm range with hard X-rays [1,2]. Increasing demand of in-situ experiment capabilities requires working distances in the order of several millimeters. This space is necessary in order to contain the experimental setup and samples. We have developed a low stress multilayer material system for MLL, which allows the multilayer deposition with a thickness of several ten micrometer [3].

References:

MLLs for high resolution X-Ray Microscopy

Properties, Methods and Experiments

One MLL focuses X-rays only in one dimension. Two crossed MLLs are required for point focusing and their relative distance has to be adjusted precisely. A large relative distance prevents the crossed MLLs to be used at different energies. This is due to the large difference in focal lengths, which scale differently with energy. However, two MLLs with a diffraction limited resolution of 15 nm and a relative distance of 10 µm optimized for 12 keV will produce a nearly symmetrical intermediate beam with a size below 20 nm for X-ray photon energies between 5 keV and 20 keV.

Point and line focus switching:
With large aperture widths the MLL setup allows switching between point and line focus. This is realized by illuminating either two crossed or only one single MLL with the beam defining slits. [5]

The technique enables users to significantly improve measurement statistics for 1D scans.

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