Performance of beam shaping X-ray optics in combination with laboratory X-ray sources

R. Dietsch[1)], Th. Holz[1)], M.Kraemer[1)], D.Weissbach[1)], St. Braun[2)]
[1)]AXO Dresden GmbH, Siegfried-Raedel-Street 31, 01809 Heidenau, Germany,
contact@axo-dresden.de
[2)]Fraunhofer IWS, Winterbergstrasse 28, 01277 Dresden, Germany

Today beam shaping multilayer X-ray optics have become standard or key components in laboratory X-ray diffraction and fluorescence equipment.
In X-ray diffraction (XRD) most of the users apply Co Kα, Cu Kα or Cr Kα radiation in their experiments. By means of these characteristic lines with relatively low photon energies in the range between E= 5.412 keV (Cr Kα) and E= 8.041 keV (Cu Kα) the q-range of the reciprocal space is limited to 80 nm^{-1}. This is not sufficient for various applications such as determination of pair correlation.
Alternatives are the application of characteristic lines with higher photon energies like Mo Kα radiation at E= 17.445 keV and Ag Kα radiation at E= 22.104 keV. The advantages of the higher photon energies are the higher penetration depth and the higher number of detectable reflections in the reciprocal space up to 200 nm^{-1}. This allows the application of capillaries with larger inner diameters without any remarkable absorption effects for example.
Multilayer X-ray optics for Ag Kα radiation are used with the standard sample LaB_6 and at other selected powder samples. Applications with 2-dimensional ASTIX-optics have been realized in addition to the already existing 1-dimensional Twin Mirror Arrangement (TMA). First results using an ASTIX-f-100 in combination with a fine focus laboratory X-ray source show a spot diameter of 40 µm (FWHM). A grating with a step size of 60µm could be resolved by means of this arrangement. A modular X-ray system for Mo Kα radiation consisting of a focusing ASTIX-f-100 optics and a micro focus X-ray source delivers a minimal spot diameter below 30 µm. This system has been applied in micro-XRD and micro-XRF measurements. In another application, a micro spot of Cr Kα radiation in the range of 105 µm (FWHM) is used for stress measurements with high spatial resolution.
Further applications using other wavelengths and source types will be discussed.