Analytical application of multilayer X-ray optics


* AXO DRESDEN GmbH, Siegfried-Raedel-Str. 31, 01809 Heidenau, Germany; contact@axo-dresden.de
** Fraunhofer Institute for Material and Beam Technology (IWS) Dresden, Germany
*** Dresden University of Technology, Inst. of Structure Physics, Dresden, Germany

The beam characteristics required in X-ray analysis, mostly dependent on the real sample, can be achieved by various X-ray optical systems that produce either low divergence (high resolution) or high intensity beams. State-of-the-art developments tend to the design of customized systems using one- or two-dimensional beam shaping multilayer X-ray optics, multilayer monochromators or the combination of multilayers with other types of X-ray optics. A close interrelation of design, film deposition, characterization and application is required to adapt these tailored systems. To fabricate multilayer X-ray optics, complementary high precision deposition technologies (MSD, LA-PLD and DIBD) have to be used. Additionally, novel 2-dimensional detectors, in comparison to conventional point detectors, allow for reduction of time of recording and exposure. This is important for the characterization of organic specimen as an example. If the sample is additionally limited in size, 2-dimensional X-ray optics like Kirkpatrick- Baez (K-B) and side-by-side (Montel) arrangements or paraboloidal or ellipsoidal multilayer optics are required.

In contrast, in X-ray powder diffraction divergent beam geometries are widely used. Nevertheless, parallel beam X-ray optics can exhibit favour advantages not only in the case of grazing incidence investigations. These parallel beam X-ray optics can allow to overcome a number of experimental problems, like influence of sample displacement on accurate angle-positions of X-ray reflections. Examples of Rietveld refinement of structure model parameters of rare-earth-nickel-boron-carbides proved the high potential of parallel beam X-ray optics for the collection of powder diffraction data for this purpose. On the other hand, the angle-resolution of the measurement can be of highest interest. With a low beam divergence, which can be realized by coupling of parallel beam multilayer X-ray optics and Channel Cut (CC) crystals, at the example of a multilayer specimen a total layer stack thickness of more than 500 nm could be measured by means X-ray reflectometry (Cu Kα radiation).