

Analytical applications of multilayer X-ray optics

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To characterize the structural and morphological parameters of compact materials and thin films X-ray diffraction and X-ray reflectometry are widely used both on laboratory X-ray sources and on synchrotrons. The required beam characteristics which mostly depend on the real sample geometry can be realized by various X-ray optical systems that produce either low divergence (high resolution) or high intensity beams. The actual 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 multilayer optics with other types of X-ray optics for a larger variety of X-ray wavelengths than the conventional $K\alpha$ emission lines. A close interrelation of design, deposition, characterization and application is required to produce these tailored systems. To fabricate either high reflectance or tailored resolution multilayer X-ray optics complementary high precision deposition technologies (MSD, LA-PLD and DIBD) with a reproducibility and long term stability in the sub-nanometer range were installed.

Parallel beam X-ray optics exhibit favour advantages for X-ray diffraction investigations especially in the low 2Θ range. These parallel beam X-ray optics overcome a number of experimental problems, increased background intensities near the primary beam and influence of sample displacement on accurate angle-positions of X-ray reflections first of all. Some examples yielded clear evidences of a high potential of parallel beam X-ray optics also for collection of powder diffraction data in reflection geometry.

Recently 2 dimensional detectors have reduced the measuring time in comparison to conventional point detectors. It allows the characterization of small organic crystalline samples. These techniques require 2-dimensional X-ray optics like Kirkpatrick- Baez (K-B) and side-by-side (Montel) arrangements or paraboloidal or ellipsoidal multilayer optics.