MULTILAYER OPTICS FOR ANALYTICAL X-RAY APPLICATIONS

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An overview of current developments of multilayer (ML) optics for laboratory-based diffractometry is given. We summarize the manufacturing process and the different types of optics. Some examples of typical applications which benefit from the new properties of ML optics, with emphasis on the combination with modern micro-focus X-ray sources, are presented.

The basis of a ML optic consists of a bent substrate with a shape tolerance below 100 nm. Several hundred layer pairs, with single layer thicknesses in the nanometer range, are deposited onto these substrates using sputtering technology. The multilayers are fabricated with lateral thickness gradients to within ± 1% of the ideal shape. Optical profilometry is used in order to characterize the shape, for the characterization of the multilayer thickness distribution, both laterally and in-depth, X-ray reflectometry is employed. The microstructure is investigated by transmission electron microscopy. Beam parameters such as monochromaticity, flux, brilliance and divergence demonstrate the high quality of the ML optics used for various applications in the home-laboratory as well as at synchrotron sources.

For laboratory based sources, the use of Montel optics to focus or collimate the beam in two dimensions enables a very high flux density as well as an adequate divergence directly at the sample position. We present results from applications such as micro-diffraction and stress analysis.