NANOLAYERS FOR X-RAY FLUORESCENCE
- DEVELOPMENTS AND APPLICATIONS -

Reiner Dietsch*, Markus Krämer, Thomas Holz, Danny Weißbach

AXO DRESDEN GmbH, Winterbergstr. 28, 01277 Dresden, Germany

Multilayers are used as monochromators in many fields of X-ray fluorescence applications, similar to crystals but also in areas where no crystals are available. Being artificial structures with tuneable parameters such as composition, period thickness and period number, multilayers are useful in numerous other applications, too. The possibility to vary the period thickness laterally for example permits to adapt the required layer spacing to varying incident angles on flat, spherical and aspherical substrates and create monochromating focusing or collimating optics. By varying the layer thickness in depth, in so-called depth graded multilayers, the monochromating properties of the multilayers can be adjusted to countless variations. Polarizers working or broadband mirrors ($\Delta E/E > 20\%$) for energies from EUV to several tens of keV are examples.

Another application of nanometer layers emerged due to the high sensitivity of modern XRF and TXRF instruments that demand for reference samples with very low mass fractions in the range of ng/mm^2 or less with homogeneous distribution of the reference element on the substrate surface. In this range standard droplet samples reach their limits due to effects of agglomeration and crystallization. Therefore we developed reference samples made by physical vapour deposition of stacks of thin metal films on silicon nitride membranes. The technique assures very homogeneous layers and a large choice of elements and mass densities. The samples were characterized by AAS, ICP-OES, TXRF in the laboratory and micro-XRF at synchrotron sources. Evaluation of µ-XRF mapping data showed that lateral mass deposition heterogeneities are below 1% (rms). Possible applications of these samples are calibration of the energy scales of ED-XRF instruments, assessment of absolute lower detection limits and characterization of depth resolution & sensitivity of confocal set-ups. Finally, reference samples with layer type depositions in the atomic monolayer and sub-monolayer range ($< 10^{15}$ Ni at/cm^2) were developed and tested for the decreasing lower limits of detection of TXRF.