Depth-graded multilayers for tailored broadband mirrors

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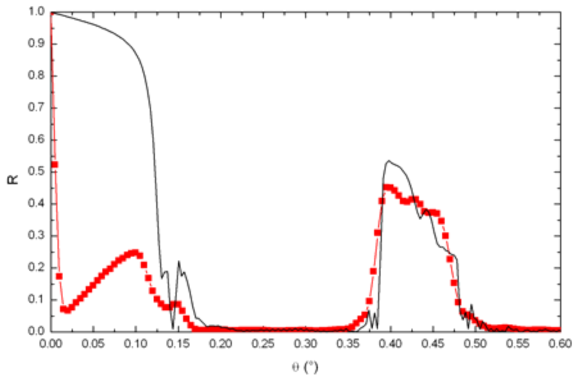
Multilayers are widely used as monochromators, similar to crystals but also in wavelength regions where no crystals are available. However, being artificial structures with tunable parameters such as composition, period thickness and number, multilayers can be applied in numerous other applications.
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 thus create monochromatizing and focusing or collimating optics, a task that is much more difficult to achieve with crystals e.g. in the Johansson geometry.
Further, by varying the layer thickness in depth, in the so-called depth-graded multilayers, the monochromatizing properties of the multilayer can be adjusted to countless variations. Polarizors working near the Brewster angle or broadband mirrors with energy bandwidths of 20% and more for energies from EUV to hard X-rays in the range of several tens of keV are prominent examples.
In this talk, a selection of "functional" beam modifying multilayers are presented that have been simulated, fabricated and tested. These range from a 17% energy bandwidth mirror for a laser plasma source around 300 eV to a 20% broadband reflector for 40 keV that is also applicable at 20 keV or up to 80 keV with similar bandwidth. Future ideas and developments are presented as well.



Figures 1-3: Simulated (-) and measured (□) reflectance of a broad band multilayer mirror at 22 keV (left) as well as simulations for the reflectivity at 40 keV and 80 keV (below left and right). The energy bandwidth ΔE/E is 20% for all graphs shown here.