A Cr/Sc Transmission Multilayer as a dual-band Quarter-Wave Plate for Soft X-Ray Polarimetry

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Abstract ---Within the last decade the performance of Cr/Sc multilayers for the soft x-ray (water-window) range has improved dramatically. They are manufactured for various applications, e.g. normal-incidence reflectors or for polarimetry applications at synchrotron radiation facilities [1,2]. They work best at the 2p absorption edges due to enhanced optical contrast and they benefit from the improved stability and careful interface engineering during sputter deposition [3] allowing for more layers to be homogeneously deposited. Cr/Sc has the advantage of allowing for operation at both Sc 2p (399 eV) and Cr 2p (573 eV) absorption edges, thus making a dual-band operation possible.

A pair of Cr/Sc multilayers for operation in transmission (freestanding) and reflection (on Si-wafer), manufactured by X-ray Company, Nizny Novgorod, Russia was used in combination as phase retarder and analyser in our polarimeter chamber [1] to deliver not only the four Stokes parameters of the BESSY undulator radiation, but also the polarising properties of the optics involved.

Here we will show the performance of this optical element designed to work at both the Sc and Cr 2p edge as a phase retarder. A phase retardation of 90 degrees has been observed at both energies at certain energy-angle working points, thus with this optic a dual-band quarter-wave plate is available now for complete conversion of linear into circular polarised light and vice versa. In addition, at the Sc 2p-edge half plate behaviour was observed at another working point to rotate the plane of linear polarisation by 90 degrees.

Thus using these novel optics together with broadband W/B_4C phase plates [4], quantitative polarimetry with primary optical standards is enabled across the EUV and SXR range.

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