

Reflection zone plate optics for ultra-fast X-ray spectrometers and monochromators

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New generation X-ray optical elements and systems for spectroscopy and monochromatization in the soft X-ray range, developed and fabricated at the Helmholtz-Zentrum Berlin (HZB), are reported. Two-dimensional variable line spacing (2DVLS) laminar diffraction grating, including reflection zone plates (RZP), have been designed, calculated, produced and tested in the laboratories of the Institute for Nanometer Optics and Technology (INT) of the HZB. These 2DVLS and RZP gratings have been used in optical systems with synchrotron radiation at BESSY II [1, 2], at free electron laser sources and the LCLS in Stanford [3] as well as in laboratory instrumentation, high harmonic generation source [4].

The feasibility of an off-axis X-ray reflection zone plate to perform wavelength-dispersive spectroscopy, on-axis point focusing and two-dimensional imaging in hard X-rays has also been tested [5]. The resolving power of a monochromator-spectrometer $E/\Delta E = 4 \cdot 10^2$ in the energy range from 7.6 keV to 9.0 keV with the focal spot size below 1 μm has been demonstrated. Supported by the grating efficiency of $\sim 18\%$ and a pulse elongation in the order of 1 fs, future precision X-ray fluorescence and absorption studies of transition metals at their K-edge on an ultra-short timescale could benefit from our findings.

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