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Towards Tender X-rays by Means of Multi-Layer Coated Gratings as Monochromator Optics

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State-of-the-art soft X-ray beamlines use collimated plan-grating monochromators (cPGM) [1] as monochromatizing devices. Multi-Layer (ML) coated plane gratings and mirrors allow to extend the available photon energy range of cPGM's towards the so-called tender X-ray photon energy range (up to 5 keV) providing a significantly higher photon flux [2]. This X-ray energy regime covers L- and M-absorption edges of most of the transition and rare-earth metals as well as K-edges of lighter elements such as silicon, sulfur and phosphorus. Recently such a ML based monochromator setup became operational at the U41-PGM1-XM beamline at the BESSY-II storage ring in Berlin [3]. This beamline upgrade enabled high resolution spectro-microscopic applications using photon energies up to 3keV. And extend its possibilities to support research e.g. on the field of life-science, semiconductor development and battery research. We will report on the design, commissioning and performance of this beamline and discuss possible options for new developments on the field of beamlines and end-stations in the tender-X-ray energy range (up to 5keV) at existing and future new accelerator-based photon sources.

1 Rolf Follath, Friedmar Senf, "New plane-grating monochromators for third generation synchrotron radiation light sources", Nucl. Instr. and Meth. in Phys. Res. A 390 (1997) 388-394

2 A. Sokolov, Q. Huang, F. Senf, J. Feng, S. Lemke, S. Alimov, J. Knedel, T. Zeschke, O. Kutz, T. Seliger, G. Gwalt, F. Schäfers, F. Siewert, I. V. Kozhevnikov, R. Qi, Z. Zhang, W. Li, and Z. Wang, "Optimized highly-efficient multilayer-coated blazed gratings for the tender X-ray region" Opt. Express 27(12), 16833–16846 (2019)

3 Stephan Werner, Peter Guttman, Frank Siewert, Andrey Sokolov, Matthias Mast, Qiushi Huang, Yufei Feng, Tongzhou Li, Friedmar Senf, Rolf Follath, Zhohngquan Liao, Kristina Kutukova, Jian Zhang, Xinliang Feng, Zhan-Shan Wang, Ehrenfried Zschech, and Gerd Schneider, "Spectromicroscopy of Nanoscale Materials in the Tender X-Ray Regime Enabled by a High Efficient Multilayer-Based Grating Monochromator", Small Methods 7 (2023), 2201382, DOI: 10.1002/smt.202201382

I plan to submit also conference proceedings

Yes

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