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The New HZB X-Ray Microscopy Beamline U41-PGM1-XM at BESSY II.

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At the BESSY II electron storage ring running by the Helmholtz-Zentrum Berlin (HZB) a transmission soft X-ray microscope (TXM) is operated very successfully for both tomographic imaging of cells [1,2] and for NEXAFS studies in materials science [3-5]. Here, we present the setup of a newly designed beamline (Fig. 1) that will significantly enhance the performance of the HZB TXM. Faster data acquisition over the whole accessible photon energy range together with a possible extension into the tender X-ray range is given. Furthermore, within the photon energy tuning range, two new important absorption edges, namely sulfur and phosphorus, will become accessible for element-specific 3D imaging, in addition to those already available, e.g. at carbon, calcium, titanium and oxygen. Another advantage of this new beamline is that phase contrast X-ray microscopy for thicker specimens will become possible in the tender X-ray photon energy range.

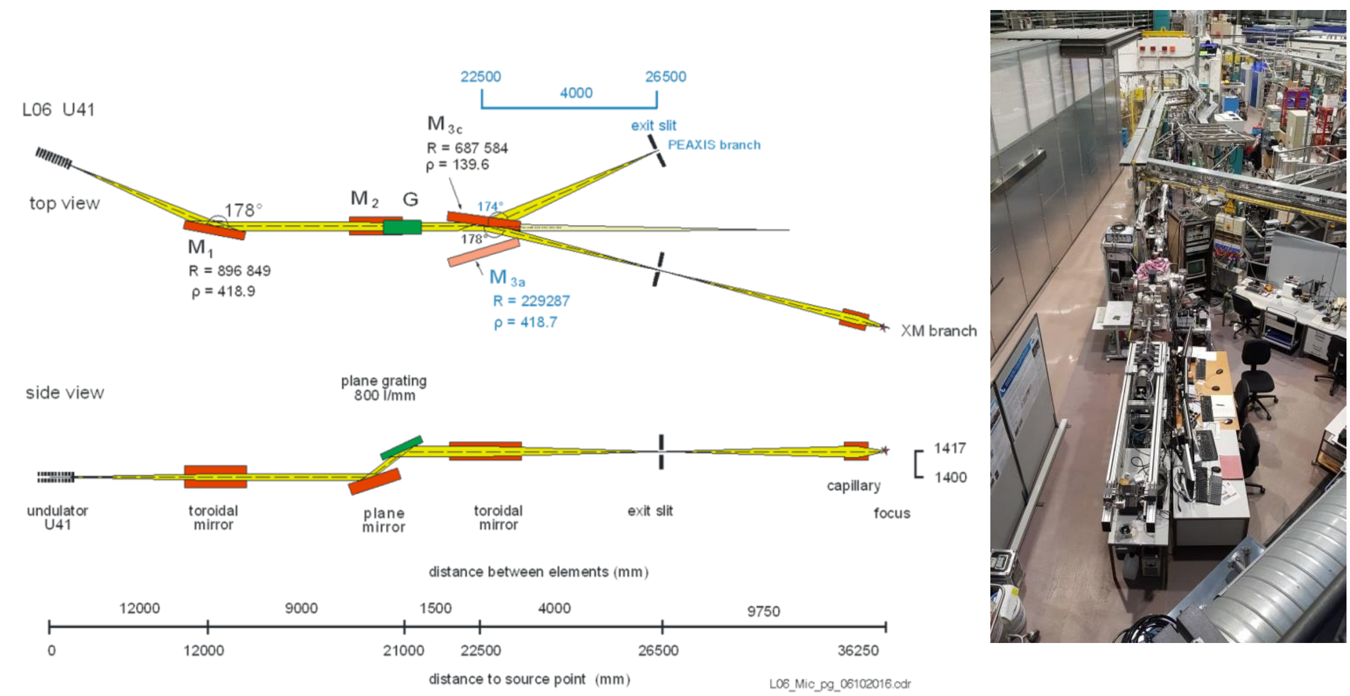

Figure. 1. Optical layout of the new HZB X-ray microscopy beamline U41-PGM1-XM (left) at the low beta section L06 of BESSY II and view on the beamline (right).

This extensive range of new capabilities was enabled by a series of key improvements. We are using now a plane grating monochromator (PGM) with a highly efficient blaze grating manufactured by the HZB Department of Precision Gratings. In addition, we have chosen grazing incidence angles of 1° for the pre-mirror M1 as well as for the mirror M3c. The mirrors are rhodium coated for high reflectivity over the whole photon energy range from 270 eV up to 2.5 keV. The optical layout was chosen in such a way that it delivers a round shaped illumination of the condenser. In addition to this new beamline design, we will present results of the metrology measurements [6,7] of the new optical elements installed in the beamline as well as the first at wavelength measurements.

At wavelength measurements shown in Fig. 2 show the high grating efficiency within the photon energy range (170 eV – 1.8 keV) provided by the U41. Figure 3 shows the measured flux curves for the first, third, fifth and seventh undulator harmonic.

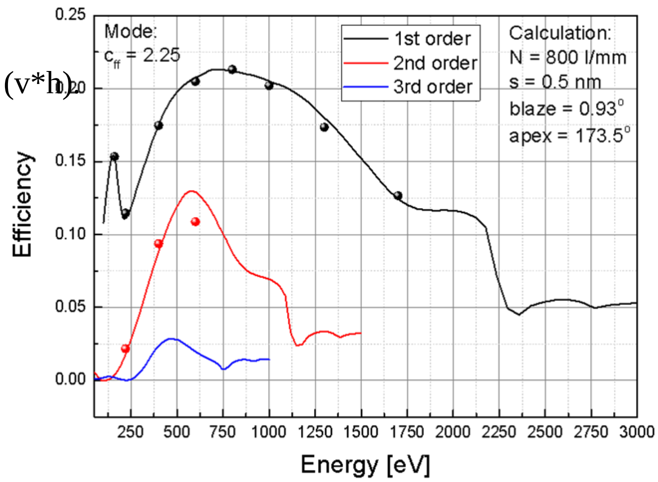

Figure. 2. Efficiency measurement of the 800 l/mm plane grating having a blaze angle of 0.93° were performed with the reflectometer of the BESSY II (HZB) Optics beamline (PM1) [8]. The beam size during the measurement was 0.36*0.2 mm^2 (v*h) and the detectors aperture were 0.14*4 mm^2 (v*h).

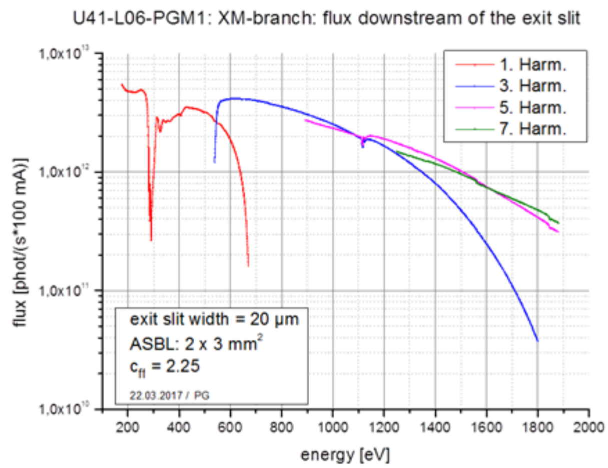

Figure. 3. Flux curves measured directly downstream of the exit slit with typical parameter settings of the front end aperture (ASBL), monochromator (c_{ff}-value) and exit slit width.

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