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Silicon Pore Optics for ESA's NewAthena X-ray Observatory: Dedicated Beamlines and Wide Range Reflectance Measurements

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NewAthena will be the largest X-ray observatory ever flown. To achieve an effective area of 1 m² at 1 keV, a total polished mirror surface of 300 m² is required due to the grazing incidence. Based on silicon pore optics (SPO), a large X-ray lens with a diameter of 2.5 m will be installed at 12 m distance from the two detectors in the focal plane. It is composed of about 500 mirror modules (MM). Each MM consist of four stacks of about 40 silicon wafers with ribs at the backside. To optimize the reflectance in the photon energy range from 0.2 up to 10 keV, the mirror surfaces will be coated with e. g. iridium and carbon layers.
Two dedicated beamlines for SPO characterization in the PTB laboratory at BESSY II provide monochromatic radiation at 1 keV and a low divergence well below 2 arcsec: the X-ray Pencil Beam Facility (XPBF 1) [1], and the X-ray Parallel Beam Facility (XPBF 2.0) where beam sizes up to 8 mm x 8 mm are available while maintaining the low beam divergence [2]. This beamline is also used to control the focusing properties of MM during their assembly at the beamline. A movable CCD-based camera system with a vertical travel range of 2 m at 12 m distance from the MM registers the direct and the reflected beam. The positioning of the detector is verified by a laser tracker. Two similar beamlines are planned to be installed in the laboratory for the mass production of MM within the next years.
Two different beamlines in the PTB laboratory, an undulator beamline with plane grating monochromator and a dipole beamline with a four-crystal monochromator, were used to measure the reflectance in several pores of differently coated MMs in double reflection over the entire photon energy range, revealing the effects due to the absorption edges and the layer thickness of the involved materials.
References:
1. M. Krumrey, L. Cibik, P. Müller, M. Bavdaz, E. Wille, M. Ackermann & M. Collon, Proc. SPIE **7732**, 77324O (2010)
2. M. Krumrey, P. Müller, L. Cibik, M. Collon, N. Barrière, G. Vacanti, M. Bavdaz & E. Wille, Proc. SPIE **9905**, 99055N (2016)

Fig. 1: X-ray lens,composed of MMs
Fig. 2: MM, consisting of ribbed silicon wafers
Fig. 3: Reflectance of an Ir coated MM at higher photon energies

I plan to submit also conference proceedings

Yes

Primary author: KRUMREY, Michael (Physikalisch-Technische Bundesanstalt)

Co-authors: GOLLWITZER, Christian (Physikalisch-Technische Bundesanstalt); SKROBLIN, Dieter (Physikalisch-Technische Bundesanstalt); VACANTI, Giuseppe (cosine measurement systems); CIBIK, Levent (Physikalisch-Technische Bundesanstalt); BAVDAZ, Marcos (European Space Agency); FECHNER, Robert (Physikalisch-Technische Bundesanstalt); COLLON, Max (cosine measurement systems)

Presenter: KRUMREY, Michael (Physikalisch-Technische Bundesanstalt)

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