On the characterization of ultra-precise mirrors for use at FEL-beamlines by use of slope measuring deflectometry

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Existing FEL facilities like FLASH and FLASH-II as well as upcoming machines like the European XFEL will require X-ray mirrors of utmost precision for the beam offset and distribution system [1] as well as for focusing of photons. The heat load on these mirrors ranges from several Watts in the time average to many kW during FEL pulse trains on the millisecond time scale. In case of the European XFEL the maximum peak-to-valley figure error allowed is less than 2 nanometers along the entire aperture length of 800mm, to enable a wave front preserving transport of photons along very long distances from its source in the undulator section to the experimental hall. Thus it is mandatory these optics to be inspected by use of metrology devices of comparable precision before and after surface finishing as well as in the mounted state. The topography of these mirrors will be inspected by use of slope measuring deflectometry [2] under face side condition the state of their final alignment. We will show and discuss first results of measurements performed on 950mm long flat-distribution mirrors before the final finishing by use of deterministic surface finishing (EEM in this case) as well as on a prototype of a 950mm long bimorph-mirror. Finally we will discuss the results of 2D-slope mapping of a Kirkpatrick-Baez-mirror system designed for focusing photons at the CAMP-experimental station at the FLASH-II-VUV-FEL at DESY.

References

[1] H. Sinn et al., *Conceptual Design Report: X-Ray Optics and Beam Transport*, xfel.eu TN-2011-002, 2011).

[2] F. Siewert et al., *On the characterization of ultra-precise X-ray optical components: advances and challenges in ex situ metrology*, J. Synchrotron Rad. (2014). 21, 968–975, doi:10.1107/S1600577514016221