Title

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High precision surface metrology of x-ray optics with an interferometric microscope

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We describe a systematic procedure developed for surface characterization of super polished x-ray optical components with an interferometric microscope. In this case, obtaining trustworthy metrology data requires thorough accounting of the instrument's optical aberrations, its spatial resolution, and random noise. We analyze and cross compare two general experimental approaches to eliminate the aberration contribution. The reference surface approach relies on aberration evaluation with successive measurements of a high quality reference mirror. The so called super smooth measurement mode consists of subtracting two surface profiles measured over two statistically uncorrelated areas of the optics under test. The precisely measured instrument's modulation transfer function (MTF) and random noise spectrum allows us to correct the aberration-amended surface topography in the spatial frequency domain. An original MTF calibration method [V. V. Yashchuk, et al., Opt. Eng. 47(7), 073602 (2008)] is based on binary pseudo-random test samples specific for a particular arrangement of the microscope in use. While the developed measurement procedure is general and can be applied to various metrology instruments, the specific results presented are from a Zygo NewView™ 7300 microscope. Supported by the U.S. Department of Energy under Contract No. DE-AC02-05CH11231.

Keywords: interferometric microscope, optical aberration, modulation transfer function, power spectral density, x-ray optics, optical metrology

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