

X-ray optics metrology limited by random noise, instrumental drifts, and systematic errors*

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Abstract:

Continuous, large-scale efforts to improve and develop third- and forth-generation synchrotron radiation light sources for unprecedented high-brightness, low emittance, and coherent x-ray beams demand diffracting and reflecting x-ray optics suitable for micro- and nano-focusing, brightness preservation, and super high resolution. One of the major impediments for development of x-ray optics with the required beamline performance comes from the inadequate present level of optical and at-wavelength metrology and insufficient integration of the metrology into the fabrication process and into beamlines [1].

Based on our experience at the ALS Optical Metrology Laboratory, we review the experimental methods and techniques [2,3,4] that allow us to mitigate significant optical metrology problems related to random, systematic, and drift errors with super-high-quality x-ray optics. Measurement errors below 0.2 μ rad have become routine [5,6]. We present recent results from the ALS of temperature stabilized nano-focusing optics and dedicated at-wavelength metrology. The international effort to develop a next generation Optical Slope Measuring System (OSMS) to address these problems is also discussed. Finally, we analyze the remaining obstacles to further improvement of beamline x-ray optics and dedicated metrology, and highlight the ways we see to overcome the problems [7].

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