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Updates on optical metrology for synchrotron mirrors at NSLS-II

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In most synchrotron applications, X-ray mirror slope specification is an important parameter for applications using a partially coherent X-ray beam. The slope error is typically specified at the sub 100 nrad RMS for mirrors up to 1000 mm long by 50 mm wide. For applications using diffraction-limited X-ray beams, height specification is a more relevant parameter to maintain and focus the beam at the diffraction limit. The typical specification is at 1 nm or even sub-nm RMS level.
These requirements, whether specified in slope or height, bring enormous challenges to synchrotron mirror metrology. This task requires dedicated metrology instruments to accurately characterize these high-precision mirrors when typical surface shapes can be flat, circular cylinders, off-axis elliptical cylinders, or even two-dimensional curved shapes. Several metrology instruments have been developed at NSLS-II to tackle these challenges to characterize these high-precision synchrotron mirrors.
With several years of research and development, our group at the NSLS-II has established a procedure for optical metrology and mirror fabrication using ion beam figuring. In our workflow, a stitching interferometer prototype based on a Fizeau interferometer is used as an in-process inspection tool to provide feedback to an ion beam figuring instrument for synchrotron optics fabrication. When the mirror is under specification, it will be inspected by other metrology instruments to make cross-validation. Various metrology instruments, including the stitching shack-Hartmann instrument, the nano-accuracy surface profiler, and the micro-stitching white light interferometer, are used as final inspection tools to characterize the optics fabricated in-house or supplied by vendors.

Journal of Synchrotron Radiation Special Issue: will you submit your contribution?

no

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