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Surface metrology of off-axis paraboloids with a Zygo phase-measuring interferometer

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Abstract text:

Increased brightness of updated 3rd generation synchrotron sources and FELs leading to smaller focused spots of x-rays has led optical designers to consider more and different methods of manufacture, and more and different figures for optical surfaces [Opt. Express. 17(20), 18271-18278, 2009]. The desire to achieve higher resolving powers for Resonant Inelastic X-ray Scattering (RIXS) also drives the interest in shapes which can focus to a point in monochromator designs. As a run up to potential future requirements in soft x-ray optical metrology, we investigate here the surface quality of off-axis paraboloids fabricated by diamond-turning. A novel method to measure off-axis parabolic optics is based on using gold microspheres as a diffraction limited back reflector in a double-bounce auto collimating geometry [SPIE Proc. 7102, 71020X (2008)]. We also discuss two other minor modifications to this experimental approach and compare them with the one using a diffraction limited ball to measure off-axis parabolic optics. Such methods may be extended, we propose, to ellipsoidally figured optics using converging rather than parallel light emerging from the interferometer.

100 word version

Brightness of 3rd generation synchrotrons and FELs leading to smaller spots of x-rays leads designers to different figures for optical surfaces. Desire to achieve higher resolving powers also drives interest in shapes which can focus to a point. To anticipate future requirements in soft x-ray metrology, we investigate off-axis diamond-turned paraboloids. A method to measure off-axis paraboloids is based on gold microspheres as diffraction limited back reflectors in a double-bounce, auto-collimating geometry. We discuss two other modifications to this approach, comparing them to the original. Such methods may be extended to ellipsoidal optics using converging light emerging from the interferometer.

Keywords: off-axis parabolic mirror, x-rays, x-ray optics, synchrotron radiation, synchrotron beamline, optical metrology, phase measuring interferometer

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Wayne R. McKinney received his PhD in physics and ultraviolet astronomy from The Johns Hopkins University in 1974. Following a post-doctoral appointment in molecular biology in the Biology Department of Brookhaven National Laboratory he designed optical systems for the NSLS. In 1979 he joined the research staff of the Richardson Grating Lab in Rochester New York, becoming Manager of Diffraction Grating R&D in 1981. In 1987 he became a staff scientist in the Center for X-Ray Optics at Lawrence Berkeley National Laboratory working on water cooled optical components and monochromator designs for the ALS. He won local and national Tech Transfer Awards, leading to Fellow status in the OSA. He now works directly for the Advanced Light Source where he built the first infrared beamlines, and the first ALS spherical grating monochromator. Currently his responsibilities are in optical metrology, particularly the adjustment of bendable x-ray optics

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