Title
MOSAIC: revisited, reformulated, and NA independent

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1. Title:	MOSAIC: revisited, reformulated and NA independent	
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7. Abstract body:

As extreme ultraviolet (EUV) lithographic systems are scaled to numerical apertures (NAs) of 0.5 and beyond, it is critical to develop reliable and accurate metrologies that work in this regime. Lateral shearing interferometry (LSI) is currently the trusted method for characterizing 0.25 NA and 0.3 NA EUV lithographic systems [1]; however, LSI alignment tolerances scale with the NA, making its implementation increasingly more difficult as NA increases [2]. While print-based methods [3-4] are attractive alternatives to coherent metrologies, the majority of these tests are currently inhibited at EUV because of their reliance on diffraction-limited resist performance.

Recently a new print-based aberration monitor was proposed that enables complete aberration characterization at 0.5 NA without diffraction-limited patterning [5]. Called MOSAIC, the method images features that probe local regions of the optic and measures how focus varies with the probe point. In other words, it maps out the local focal length of an imaging system throughout its pupil. In this paper MOSAIC is reformulated to enable the aberrations to be recovered on a sphere instead of the plane. This new approach mitigates all NA dependence and greatly simplifies the mathematical formulas involved. Following a sensitivity analysis that identifies the optimal object and illumination settings, a model-based proof of principle recovers the aberrations of the SEMATECH Berkeley 0.3 NA Microfield Exposure Tool with 4.2% RMS error: an error 4X smaller than the reported errors of the original LSI measurement [1]. This work was supported by the Director, Office of Science, of the U.S. Department of Energy under Contract No. DE-AC02-05CH11231.

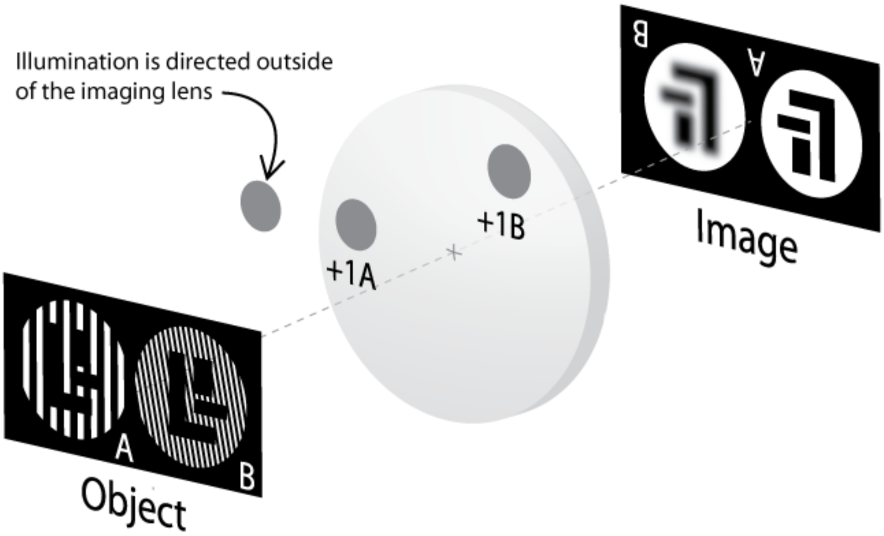

Figure 1: The holographic mask contains a test feature encoded on two different spatial carriers A and B. Off-axis coherent illumination steers the zero order (undiffracted) light outside the pupil. The +1 order diffracted light from carriers A and B (containing the test feature) probe the optic at different locations to form images of the test features in the image plane. When the optic is aberrated, each probe region may have a different focal plane. This effect is illustrated by showing feature A in focus and feature B out of focus.

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