Iterative procedure for in-situ optical testing of EUV exposure tools with an incoherent source

Ryan Miyakawa[1,2], Patrick Naulleau[2], Avideh Zakhor[1]

[1]University of California, Berkeley, [2]Lawrence Berkeley National Laboratory

Interferometry has long been the standard method for characterizing the aberrations in optical systems. However, since most EUV exposure tools use light from incoherent sources, interferometry cannot be used in-situ. We propose an in-situ iterative procedure that solves for the aberrations in an incoherent or partially coherent imaging system. In this procedure, a mask with known features is imaged and printed at multiple planes through focus. The analysis employs the Hopkins equation with a test set of pupil aberrations to determine the subsequent intensity distribution in the various image planes that are matched to the experimental results. The resulting error function is used to feedback to a new test set of pupil aberrations and the process is repeated iteratively until the error function is within tolerance. A simulated annealing method is used to minimize the error function with respect to the first 37 Zernike Polynomials as well as simultaneously optimizing the host function used in the resist model. Since the Hopkins equation is notoriously computationally taxing, a variant the Sum of Coherent Systems (SOCS) decomposition developed by Zakhor et al.[3] is employed that performs a spectral decomposition on the Hopkins integrand that can improve computation times over commercially available partially coherent imaging algorithms by a factor of 10 or more.