Robust Design and Material Optimization for Multilayer Coatings for BlueX Wavelengths

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Blue-X lithography proposes transitioning the operating wavelength from the current 13.5-nm EUV to the 2-4 nm wavelength range. Such systems will rely on multilayer (ML) reflective optical elements for beam formation, photomask illumination, and optical projection. Direct scaling of multilayer designs from EUVL wavelengths is challenging due to the lack of available materials with high index contrast, fundamental design limitations and the impact of surface roughness and interlayer mixing on achievable reflectance.

In this presentation, we will show our systematic approach to identifying optimum ML pair materials for 2.48 nm nitrogen plasma wavelength as well as other wavelengths in the water window region. We will further describe machine-learning driven custom optimization approaches, including aperiodic designs, applied to these large number-of-layer stacks to optimize spectral and angular bandwidths of the coating performance.

Based on ML material downselection, we will describe our custom thin film deposition optimization aimed at minimizing layer roughness and interdiffusion. We stress the need both for using precise and high—spectral-resolution material optical properties and for detailed measurement of multilayer stack reflectance.

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