Non-Specular EUV Scattering from Multilayers at Normal Incidence

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Non-specular scattering reduces the throughput of an optical system and degrades the image contrast. Measurements have been performed of non-specular scattering of EUV radiation normally incident on Mo/Si multilayer coated mirrors. Scattering from replicated substrate roughness is observed for multilayers deposited on rough substrates. At small scattering angles the roughness is conformal and the power spectral density (PSD) may be readily deduced from the scattering distribution. The PSD so obtained is found to be in excellent agreement with AFM and optical profiler measurements of the substrate.

At wavelengths shorter than the Bragg wavelength, a peak is observed in the angular scattering distribution, as expected from conformal roughness. However, it is found that the scattering distribution exhibits an unexpected asymmetry, which indicates that the roughness is anisotropic. The observed anisotropy is found to be associated with the multilayer deposition and is not replicated substrate roughness. By including the average deposition angle into a stochastic multilayer growth model we are able to obtain remarkable agreement with the observed asymmetry.