Reflective EUV diffusors

Torsten Feigl[1], Hagen Pauer[1], Marco Perske[1], Tobias Fiedler[1], Philipp Naujok[1], Guido Hergenhan[2], Christian Ziener[2], Mark van de Kerkhof[3], Ad Schasfoort[3], Frank Scholze[4], Christian Laubis[4]

[1]optiX fab GmbH, Hans-Knöll-Str. 6, 07745 Jena, Germany
[2]JENOPTIK Optical Systems GmbH, Göschwitzer Strasse 25, 07745 Jena, Germany
[3]ASML Netherlands B.V., De Run 6501, 5504 DR Veldhoven, The Netherlands
[4]Physikalisch-Technische Bundesanstalt, Abbestr. 2-12, 10587 Berlin, Germany

Since the early 80s of last century, the EUV multilayer community is trying hard to minimize multilayer interface roughness and interdiffusion in order to increase the (specular) EUV reflectivity of EUV multilayer mirrors. Developing optical elements that scatter EUV light at 13.5 nm wavelength into a defined angular range require a different approach: The increase of the interface roughness within a multilayer structure.

This paper presents different approaches to realize reflective EUV diffusors that reflect 13.5 nm EUV light into a broad angular range. The vertical (rms roughness) and lateral (correlation length) dimensions of the multilayer interface roughness have been optimized accordingly resulting in a complete disappearance of the specular reflectance peak.

Node resolution will increase faster than NA increases in future EUV scanner systems, resulting in decreasing k1-factors and tightening of aberration requirements. Thus, reflective EUV diffusors are crucial components of NXE high-NA EUV scanners to fill the full pupil of the projection optics appropriately for measuring and controlling aberrations in-situ.

Keywords: EUV, EUV scattering, EUV diffusion, EUV multilayers, roughness, correlation length