Actinic Metrology Of The Schwarchild Objective By Using A Wavefront Sensor

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For rapid screening of mask defects in extreme ultraviolet lithography at-wavelength (actinic, λ = 13.5nm) microscopes in the application lab are required. The main requirements are: (i) magnification of between 25 and 50X, (ii) resolution around to 100 nm, (iii) free of third order aberration, specially in full field imaging, (iv) affordable for multi-application in user lab.

The Bern group developed a Schwarzschild objective that meets all the characteristics mentioned above [1]. Four different Schwarzschild geometries, depending on the illumination source, were investigated. A ray tracing study has been performed which indicated the optimum Numerical Aperture (NA). For wide-angle illumination, i.e. gas discharge gas source, the NA is 0.15 to 0-17 depending on the eccentricity of the mirrors. The NA for collimated sources, i.e., X-Ray Laser, is 0.025 to 0.030 depending if a partial Schwarzschild is used or an off-axis instead. The multilayer mirrors have been optimized for 12 nm of wavelength and for incidence angle of a sample at 130 nm to the primary mirror of the Schwarzschild.

The experiment was performed using a Hartmann aberrometer with a grid of 34 x 34 holes of a length of 110 x 110 μm. . The light source high harmonics generated at 32 nm of wavelength by focusing a Ti:Sapphire laser onto a Argon gas cell.

The goal of this study was to characterize the Schwarzschild mirror 's wavefront (phase aberration). The variations on the wavefront are used in order to obtain information about the parametrization and shape of the mirrors and some possible defects likewise as the alignment of the primary mirror respect to the secondary.

[1] M. Ruiz-Lopez, et. al., Applied Physics B, doi*: 10.1007/s00340-013-5606-z,* (2013)