

Mask Observation Result using Coherent EUV Scattering Microscopy at New SUBARU

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For metrology of actinic EUVL mask, we have developed a coherent EUV scattering microscope (CSM) at BL-3, NewSUBARU. The lens-less imaging, which have been developed in X-ray region [1], could provide an aberration free diffraction-limited imaging with a high numerical aperture.

Figure 1 shows schematic layout of the CSM composed with a 200 nm thick Zr filter, a pinhole of $\phi 5 \mu\text{m}$, two Mo/Si multilayer mirrors for focusing and turning, an EUV mask, and a back-illuminated CCD (1 inch 2048×2048 pixels). The angle of incidence of coherent light to the mask was 6 degree same as EUVL. Coherent scattered (diffracted) light from the actinic pattern was recorded with the CCD, where the distance from the mask was about 100 mm ($\text{NA} \sim 0.12$). An aerial image of the sample was reconstructed by HIO algorithm [2], which could retrieve phase from an oversampled intensity data.

Grating and hole pattern masks were observed, which were fabricated with our e-beam lithography system (ELIONIX ELS-3700) and ICP etcher. Figure 2 (a) and (b) shows a CCD image of a 200 nm pitch grating mask and a reconstructed image, respectively. The reconstructed line width is well corresponding to the SEM image.

References

- [1] Jianwei Miao, Pambos Charalambous, Janos Kirz, and David Sayre, *Nature* **400**, 342 (1999).
- [2] J.R. Fienup, *Appl. Opt.* **21**, 2758 (1982).

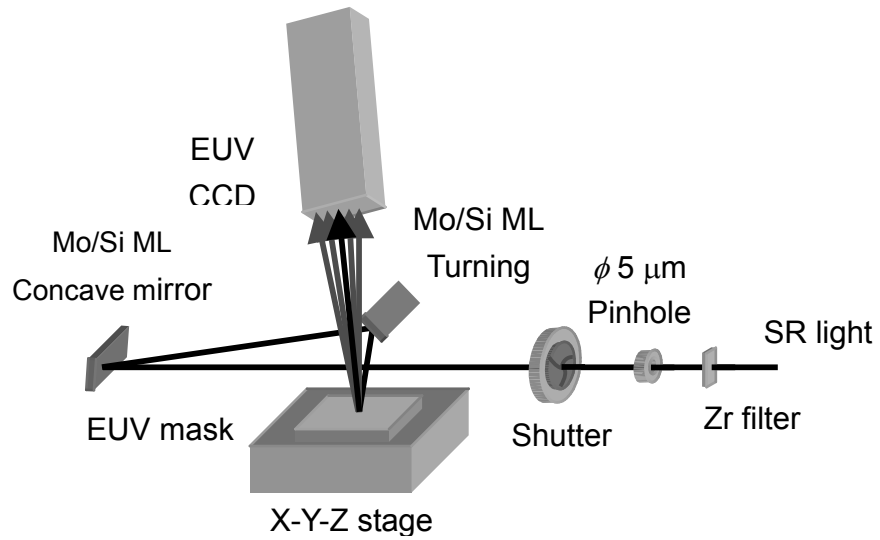


Figure 1. Schematic layout of the coherent EUV scattering microscope at BL-3, New SUBARU. The coherence of the white SR light was improved by the pinhole and multilayer reflection bandwidth.

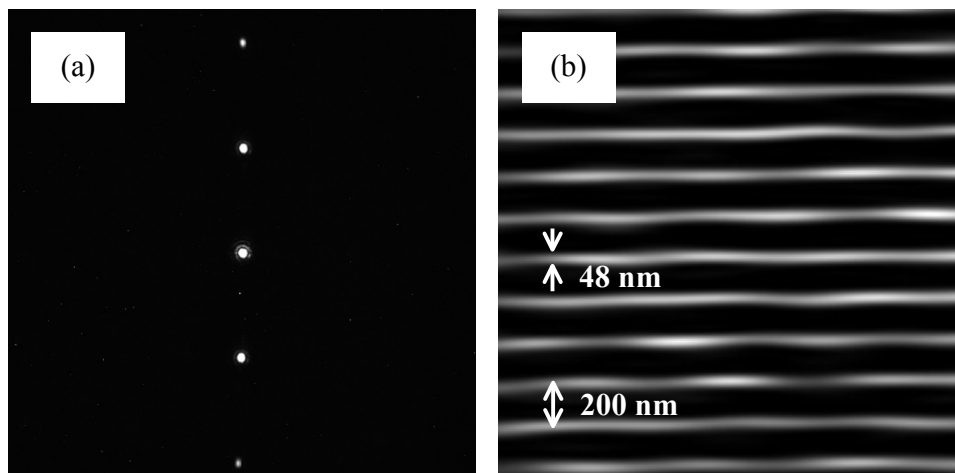


Figure 2. (a) CCD image of coherent scattering light from the grating mask of 200 nm pitch and (b) reconstructed image with HIO algorithm.