Evaluation of EUVL Mask Absorber Pattern on Multilayer Phase Defect Using EUV Microscope

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Defect-free mask is one of the critical issues to lead EUV lithography (EUVL) into manufacturing. So, we developed EUV microscope and reported its observation results of phase defect of EUV mask blanks in 2005. It was demonstrated that the multilayer phase defect with 100-nm-wide and 2-nm-depth was printable[1]. In this time, we report the further observation results of absorber pattern on the mask blanks with programmed phase defect.

The mask sample has several programmed phase defect on the 6025-format ULE glass substrate as shown in Fig. 1. Figure 2 shows EUV microscope images and the light intensities of 190-nm-wide line-shaped phase defect at several positions between 400-nm-wide absorber lines. The height of these phase defects are 12 nm.
As shown in Fig. 2, reflected light from defect part was lower than defect-free part, and have an effect to the CD of the reflected part (multilayer). The change of CD is in proportion to the size of the phase defect on multilayer.
Figure 3 shows the EUV microscope image of 400-nm-wide absorber patterns on the 300-nm-wide programmed phase defect which intersected at right angle to absorber patterns. The CD change of absorber pattern at the programmed defect part was approximately 100 nm.

In this paper, we will discuss the detail of these results and quantify the efficiency to CD.

Reference

[1] K. Hamamoto, et. al.: Jpn. J. Appl. Phys. **45** (2006) 5382.

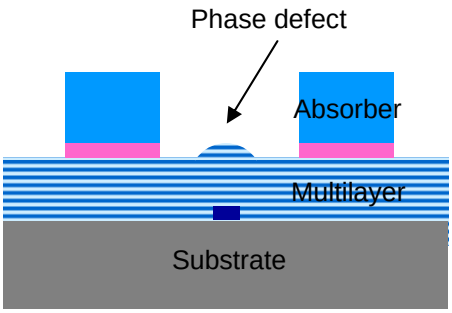
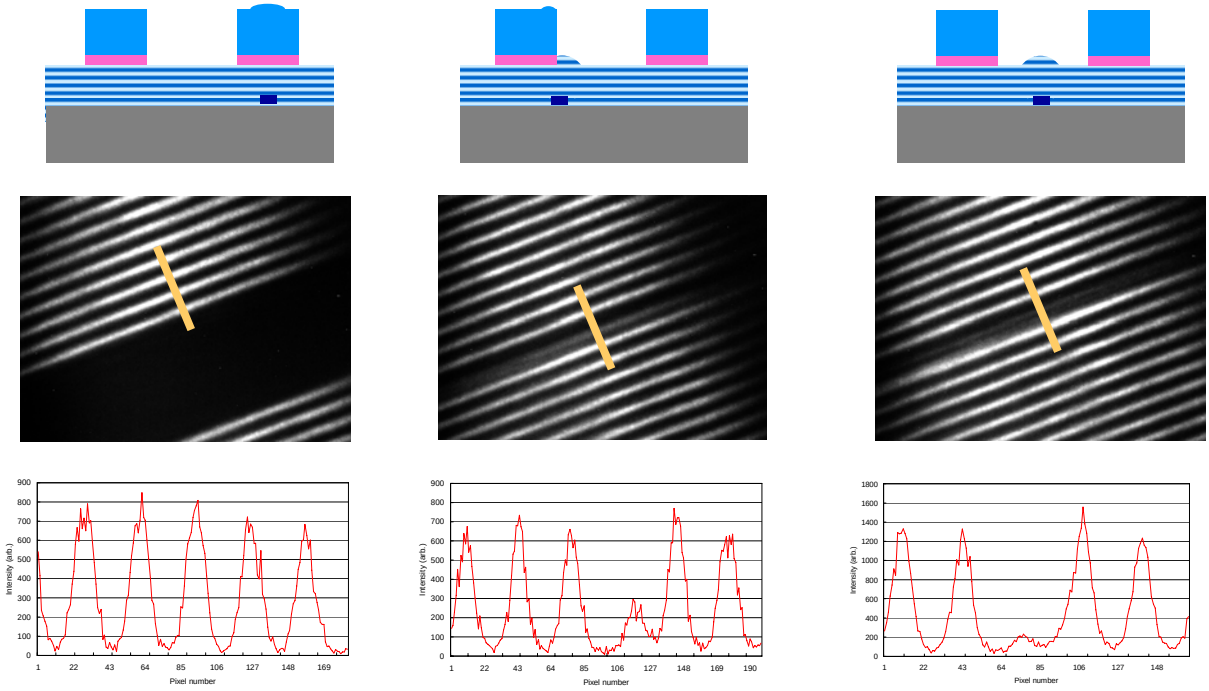


Fig. 1 Structure of the mask sample.



(a) (b) (c)

Fig. 2 EUV microscope images of 190-nm-wide line-shaped phase defect at several positions between 400-nm-wide absorber lines and their light intensities. (a) phase defect exists under the absorber, (b) phase defect exists at the edge of absorber, and (c) phase defect exists between absorber lines.

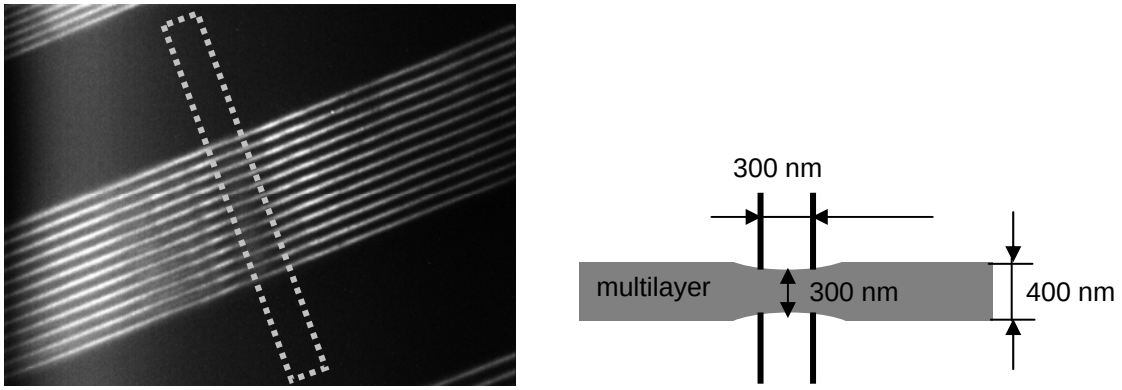


Fig. 3 EUV microscope image of 400-nm-wide absorber patterns on the 300-nm-wide programmed phase defect.