Unveiling success rate of defect mitigation by experiment with EUV Actinic Blank Inspection Prototype for 16 nm hp

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For Extreme Ultra-Violet Lithography (EUVL), fabrication of defect free multi-layered (ML) mask blanks is one of the difficult challenges. ML defects come from substrate defects and adders during ML coating, cannot be removed, and are called as phase defect (PD).

Ideally, we would like to have an ML blank with no printable PD, but this is one of the difficult challenges. And even to reduce PDs, high investments will be needed for good blank yield by improving substrate material, polishing, blank handling, ML coating and so on. However, if we can accept ML blanks with certain counts of PDs, the blank yield will be drastically up and high investments won't be needed. Some researchers have been proposing use of such blanks with certain numbers of PDs by defect mitigation schemes. Those proposals are coverage of PDs by absorber pattern[1], proximity repair of mask absorber pattern to compensate the influence from PD[2]. In each scheme, the PDs need to be identified and located during ML blank defect inspection before absorber patterning for pattern shift and compensation. To locate PDs on the blanks accurately and precisely, Fiducial Marks (FM) on ML blanks are needed for mask alignment and defect location information. The proposed requirement of defect location accuracy is better than 10 nm[3].

We fabricated FMs by resist exposure by E-Beam writer and etching process as shown in Fig. 1, and inspected FMs with EUV Actinic full-field mask Blank Inspection tool developed by EIDEC-LaserTec (LT ABI) for 16 nm hp. Then we estimated FM registration accuracy for several line widths and depths. And we also evaluated location accuracy of PDs on mask.

In this paper, we will estimate defect location accuracy by using FM and LT ABI, and discuss success rate of defect mitigation schemes by considering previous study[4] and above experimental results.
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[1] P. Y. Yan and C. Wagner, Proc. SPIE Vol. 5374, 254-260, 2004.
[2] A. K. Ray-Chaudhuri, G. Cardinale, A. Fisher, P. Y. Yan, and D. W. Sweeney, J. of Vac. Science & Tech B(17), 3024-3028, (1999).
[3] P. Y. Yan, Y. Liu, M. Kamna, G. Zhang, R. Chen, and F. Martinez, Proc. SPIE Vol. 8322, 83220Z (2012).
[4] T. Murachi, T. Amano, and S. H. Oh, Proc. SPIE Vol. 8522, 85221U, (2012).

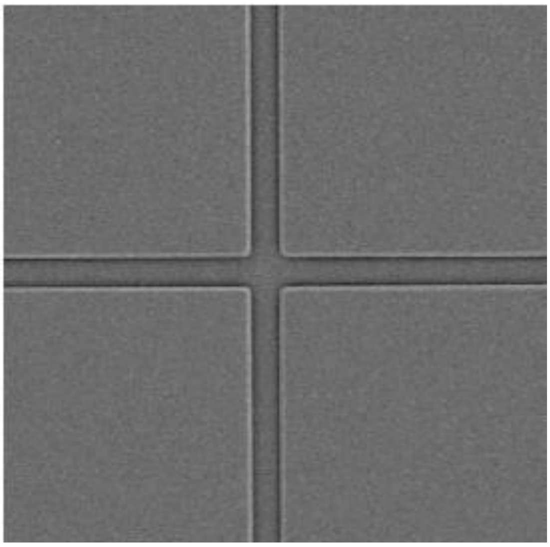

Figure 1. FM image taken by SEM (10k magnification). 7 μm line width, 300 nm line depth and 550 x 550 μm size (target).