Technical issue of EUVL and prospect for EUVL and Beyond EUVL

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Abstract

EUV research has been carried out since 1996 at the laboratory of Advanced Science and Technology for Industry, University of Hyogo. And the Center for EUVL established in Oct. 2010 at our lab to accelerate EUV research toward production usage.

Research of EUV resist, mask, optics and so on has been carried out with leading and joint the four national projects in Japan within approximately 20 years, and collaborating with many companies inside and outside Japan.

Recently EUVL started to use in HVM from 2019 to produce 7 nm logic devices. However, technical issues still remain. The EUVL technical issues for more advanced patterning are 1) EUV resist with high resolution, high sensitivity, and low line edge roughness, 2) defect free mask and its handling including defect inspection through a pellicle, and 3) high power and high stability EUV light source.

In this talk, the recent fundamental researches of mask and resist will be introduces.

For the achievement of low LWR, the chemical contents spatial distribution analysis is necessary using resonant soft X-ray scattering to analyze the aggregation and segregation inside the thin resist film. And also the PEEM system using in soft X-ray region will be introduced for that.

Especially, since the ASML exposure tool is operated under the hydrogen environment, the hydrogen brittle evaluation of mask and resist become very significant. It is introduced that the exposure tool which can evaluate hydrogen brittle of mask materials such as multilayer pellicle, and resist et al in high EUV power of 30 W/cm^2 at the hydrogen pressure of 70 Pa. The 10.8-m-long undulator employed as a EUV light source which can generate high brilliance of EUV wavelength region. This undulator is the largest size in soft X-ray region facility. To realize the high power EUV, the beamline setup was improved. It is introduced the results of hydrogen brittle evaluations on a basis of reflectivity measurements.

For the patterning in single nanometer level, shortening the wavelength to one half of EUV wavelength of 13.5 nm, so called this lithography is Beyond EUV lithography. The possibility of BEUVL is discussed.

Biography

Takeo Watanabe received his Ph.D. from Osaka City University in 1990. He is Full Professor, Director of Center for EUV, and Dean Laboratory of Advanced Science and Technology for Industry, Executive Advisor to the President, University of Hyogo. He is an expert of the EUV lithographic technology, including optics, exposure tool, mask and resist related technologies. He has authored over 250 technical papers.

And now, he is the President of the International Conference of Photopolymer Science and Technology (ICPST). He is also Conference Chair of the International Conference of Photomask Japan. And he is a program committee member of the International Conference on Electron, Ion, and Photon Beam Technology and Nanofabrication (EIPBN).