Validity of the measurement accuracy in the EUV interferometer

Masahito Niibe, Katsumi Sugisaki[1], Masashi Okada[1], Seima Kato[1], Chidane Ouchi[1], and Masanobu Hasegawa[1]

Laboratory of Advanced Science &Technology for Industry, University of Hyogo,
3-1-2 Kouto, Kamigoori, Ako-gun, Hyogo 678-1205 Japan
[1]*Extreme Ultraviolet Lithography Association (EUVA)*
Nishimotokousan Bldg., 3-23 Kanda Nishiki-cho, Chiyoda-ku, Tokyo 101-0054 Japan

Abstract. In extreme ultraviolet lithography (EUVL), which is an influential candidate for an exposure system for the semiconductor devices of next generation, wavefront error of the projection optics has to be less than 0.45 nmRMS. To realize such a high accuracy projection optics, a wavefront measurement system was developed using a EUV interferometer technology at the exposure wavelength of 13.5 nm. The system is possible to carry out the measurements of six different interferometric techniques, such as (a): point diffraction interferometer (PDI), (b): line diffraction interferometer (LDI), (c): cross-grating lateral shearing interferometer (CGLSI), (d): digital Talbot interferometer (DTI), (e): lateral shearing interferometer (LSI), and (f): double-grating lateral shearing interferometer (DLSI). The desired value of measurement accuracy of the system was under 0.1 nmRMS.

Until now, the interferograms of a Schwarzschild test optics were able to be acquired by all the above six methods, and the wavefronts were retrieved. The results are shown in Fig. 1. The measured wavefronts were not only similar in RMS values but also very similar in shapes.

To verify the measurement accuracy, the measurements were repeatedly carried out by rotating the optics from 0° to 90°, 180° and 120° around the optical axis. The systematic error of the measurements was estimated by the difference of the wavefronts, for example, measured at the optics azimuth of 0° and 90°. Ultra-high-accuracies with repeatability of 0.048 nmRMS and systematic errors of 0.06 nmRMS for the PDI and 0.12 nmRMS for the CGLSI were realized.

This work was performed under the management of EUVA as a research and development program of NEDO/METI, Japan.

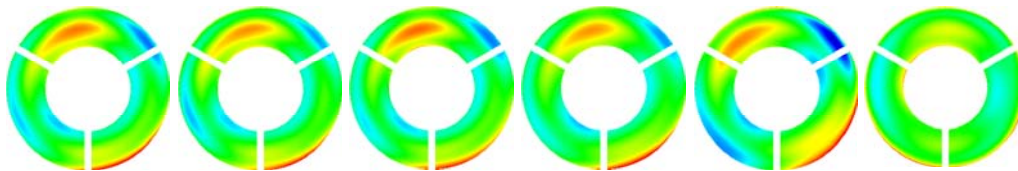

Fig. 1 Wavefront measurement results of the test optics by various interferometer techniques.