Stand-alone extreme ultraviolet (EUV) metrological system for optical characterization of lithography materials

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With the rapid growth of data-intensive applications such as autonomous driving and artificial intelligence, the performance requirements of semiconductor devices have significantly escalated. In parallel, the critical dimensions of circuit patterns have been reduced to the nanoscale, necessitating the adoption of extreme ultraviolet (EUV) lithography to overcome the resolution limits of conventional ArF-based photolithography [1]. As line widths shrink below the resolution limits of traditional methods, the development of key EUV-compatible materials—such as photoresists and pellicles—has become imperative. Accurate characterization of these materials at the EUV wavelength of 13.5 nm is essential; however, most EUV metrology facilities rely on synchrotron radiation sources, which are limited in availability and accessibility. This underscores the need for a compact, portable EUV measurement system capable of supporting industrial-scale evaluation demands.

In this study, we present the development of a miniaturized EUV characterization platform employing a Z-pinch plasma EUV source as shown in Fig. 1. The system comprises an EUV light source, an optics chamber with a high-reflectivity optical assembly, and a sample chamber for sample evaluation. Discharge parameters were optimized to maximize emission at 13.5 nm, achieving an optical intensity of 3.5 W/cm². Using this setup, we performed pattern transfer verification on a metal-oxide resist (MOR)-based EUV photoresist sample with a line/space (L/S) structure, enabling quantitative assessment of the resist's sensitivity and contrast. Furthermore, by measuring EUV power variations, we validated the system's capability to evaluate EUV transmission properties of pellicle candidates.

The developed system offers a promising solution for the comprehensive optical evaluation of EUV-specific materials and is expected to facilitate rapid material screening and iterative development in EUV lithography processes.

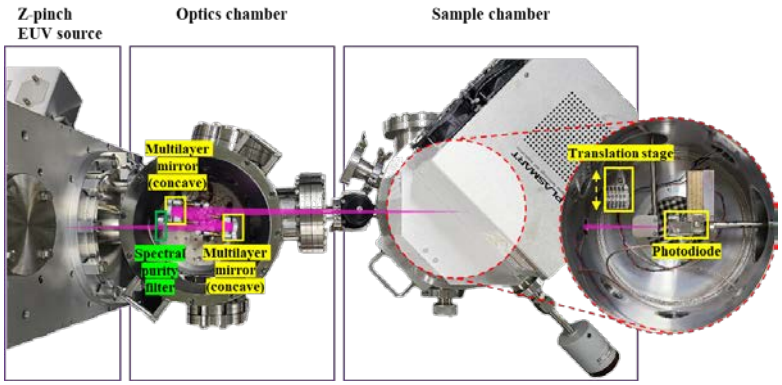

Figure 1. System configuration of the stand-alone EUV metrological system

[1] G. Tallents, E. Wagenaars, and G. Pert, 2010, Nature Photonics **4**, 809.