Analysis of EUV Resist Outgassing by Multi-analysis High-Vacuum System

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Significant progress has been made these past few years in the field of optical lithography. Most of the credit goes to the implementation of 193nm immersion lithography and related resolution enhancement technologies. However, as pattern dimensions continue to become smaller than the 45nm node, achieving a stable process for volume-production may prove to be difficult, even with this technology. To provide the new answers to this challenge, Extreme Ultraviolet Lithography (EUVL) comes out as the strongest candidate.

In EUVL, resists are one of the most critical issues in its realization for use in actual semiconductor device manufacturing below the 32nm node. At present, no resist concurrently meets the targets for resolution, sensitivity, and line width roughness (LWR). Another concern is resist outgassing at these highly energetic wavelengths under vacuum. At high volume manufacturing, there is a huge concern about contamination of the exposure tool optics.

In efforts to protect very precise EUV optics, all resist materials to be used in EUV vacuum exposure chambers must be screened prior to use. We have designed a novel outgas analysis system to ensure the safety of various optical elements from the possibility of outgas contamination from the resists as well as analysis of these outgas elements.

In this 300mm wafer-compatible system, a stand-alone EUV source (EQ-10MR by Energetiq technology, inc.) of comparatively high power output is utilized for accelerated outgassing evaluations at ultra-high vacuum conditions (10^{-7}Pa). Various outgas evaluation methods were also made available for use in this system. Quadropole mass spectrometry (QMS, range: 1-300amu), gas chromatography - mass spectrometry (GC-MS), quartz crystal microbalance (QCM) and 'witness mirror' analysis methods are utilized to accurately capture and quantify resist outgassing elements that may be released before, during and after EUV exposure (Fig. 1).

The results of the system performance evaluations will be discussed in the conference. Also, using the above mentioned evaluation methods, the analysis and definition and quantification of various resist outgassing elements and their respective release mechanisms will be reported.

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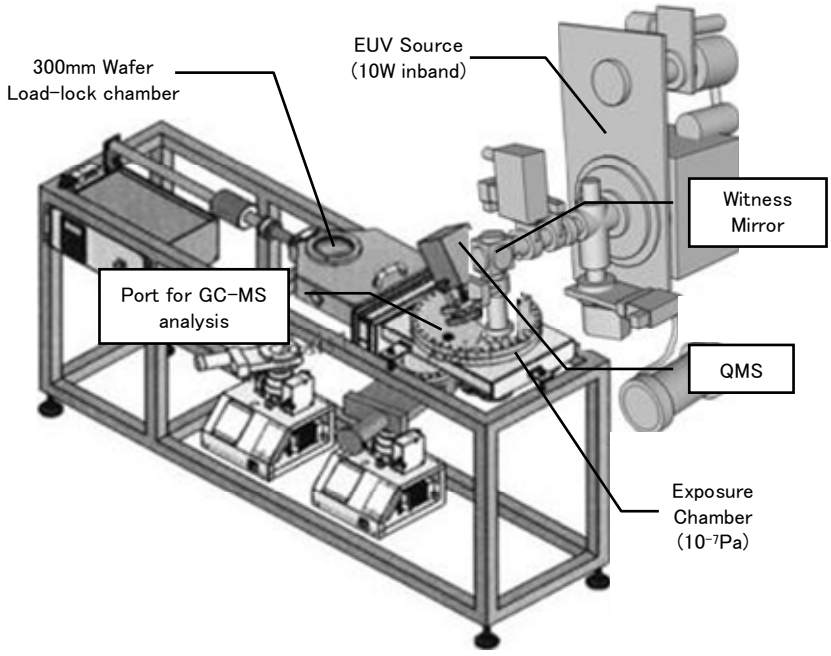

Fig. 1. The EUV resist outgas analysis system equipped with multi-analysis methods such as Quadropole mass spectrometry (QMS, range: 1-300amu), gas chromatography - mass spectrometry (GC-MS), quartz crystal microbalance (QCM) and 'witness mirror' analysis methods to accurately capture and quantify resist outgassing elements that may be released before, during and after EUV exposure.