Optical emission spectroscopy at a foreline for monitoring plasma processes

Dae-Woong Kim [1], Min Hur [1], Jin Young Lee [1], Woo Seok Kang [1], and Jae-Ok Lee [1]

[1]Korea Institute of Machinery and Materials, Korea, Republic of

Recently, advanced process control based on in-situ diagnostics results of the process have attracting considerable attention due to the significantly decreased process window for the 3D FinFET process and 3D NAND process. Monitoring gas species including byproduct in the foreline of the process chamber provides useful process information, for example the end-point-detection, the throughput prediction, the leak detection, the fault detection, and etc. The optical emission spectroscopy for monitoring an independent plasma module attached to the foreline, that is referred as the foreline optical emission spectroscopy (FOES) or the self-plasma optical emission spectroscopy, is promising diagnostics technique for the in-situ monitoring gas species thanks to its non-invasive and in-situ characteristics. However, for the FOES to become a robust diagnostic technique, the following issues must be improved: First, the degradation of optical signals due to the window contamination coming from its exposure to the reactive plasma. Second, the unstable plasma discharge under wide pressure conditions of the foreline. Third, an insufficient optical signal intensity for target gas species.

In this presentation, we present application results using the improved FOES for monitoring plasma processes of deposition and etching. Based on the real processes, we obtained the target pressure region for the FOES. The electrode structure and the power condition of frequency and magnitude for discharging the plasma in the foreline were optimized depending on the foreline environment for the stable discharging. In addition, the degradation of optical signals due to the contamination was improved through the investigation of the view port structure and the modification of the electrical structure.