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Real-Time Small Exposed Area SiO₂ Films Thickness Monitoring in Plasma Etching Using Plasma Impedance Monitoring with Modified Principal Component Analysis

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Film thickness monitoring with plasma impedance monitoring (PIM) is demonstrated for small area SiO₂ RF plasma etching processes in this work. The chamber conditions were monitored by the impedance signal variation from the I-V monitoring system. Moreover, modified principal component analysis (mPCA) was applied to estimate the SiO₂ film thickness. For verification, the PIM was compared with optical emission spectroscopy (OES) signals which are widely used in the semiconductor industry. The results indicated that film thickness can be estimated by 1st principal component (PC) and 2nd PC. Film thickness monitoring of small area SiO₂ etching was successfully demonstrated with RF plasma harmonic impedance monitoring and mPCA. We believe that this technique can be potentially applied to plasma etching processes as a sensitive process monitoring tool.

Keywords: Plasma etching, Film thickness monitoring, Principal component analysis, Plasma impedance monitoring