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Modified Principal Component Analysis for Real-Time Endpoint Detection of SiO2 Etching Using RF Plasma Impedance Monitoring

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Plasma etching is used in microelectronic processing for patterning of micro- and nano-scale devices. Commonly, optical emission spectroscopy (OES) is widely used for real-time endpoint detection for plasma etching. However, if the viewport for optical-emission monitoring becomes blurred by polymer film due to prolonged use of the etching system, optical-emission monitoring becomes impossible. In addition, when the exposed area ratio on the wafer is small, changes in the optical emission are so slight that it is almost impossible to detect the endpoint of etching. For this reason, as a simple method of detecting variations in plasma without contamination of the reaction chamber at low cost, a method of measuring plasma impedance is being examined. The object in this research is to investigate the suitability of using plasma impedance monitoring (PIM) with statistical approach for real-time endpoint detection of SiO_2 etching. The endpoint was determined by impedance signal variation from I-V monitor (VI probe). However, the signal variation at the endpoint is too weak to determine endpoint when SiO_2 film on Si wafer is etched by fluorocarbon plasma on inductive coupled plasma (ICP) etcher. Therefore, modified principal component analysis (mPCA) is applied to them for increasing sensitivity. For verifying this method, detected endpoint from impedance analysis is compared with optical emission spectroscopy (OES). From impedance data, we tried to analyze physical properties of plasma, and real-time endpoint detection can be achieved.

Keywords: Plasma impedance monitoring, Endpoint Detection, Principal component analysis, oxide etching