Sensitivity Enhancement of Optical Signals for Plasma Etching Endpoint Detection with Discrete Wavelet Transform and Clustering Analysis Method

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The plasma etching process in semiconductor manufacturing industry becomes more complicated to control, and it is essential to improve monitoring sensitivity of plasma signals to operate reproducible plasma processes. In this study, discrete wavelet transform (DWT) was applied to etching endpoint detection (EPD) with optical emission spectroscopy (OES) for developing the effect of signal sensitivity enhancement using modified K-means cluster analysis (KMC). DWT is a signal transform technique that decomposes process signals into several sets using wavelet, and it was used as low frequency pass filter to improve signal to noise ratio (SNR) of OES signal. KMC is clustering analysis method and it was modified for real-time endpoint detection. Modified KMC was applied to SiO_2 etching with relative areas of 8.0, 4.0, and 1.0 %. The signal sensitivity of OES signals was improved by about 3 times with modified KMC. DWT improved the sensitivity enhancement effect of modified KMC by about 3 times. Therefore, the introduction of DWT is appropriate to improve the clustering technique to increase the signal sensitivity of the plasma etching process.