Sensitivity Enhancement of Optical Signals for Plasma Etching Endpoint Detection with Modified Clustering Method

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The plasma etching industry becomes complicated to control as critical dimension decreases. In plasma etching process in semiconductor manufacturing, etching endpoint detection (EPD) is conducted to stop etching process at appropriate moment. As process pressure decreases and the open area of target becomes smaller, conventional EPD becomes difficult due to reduced sensitivity of signals. In this work, modified clustering methods were applied to the optical signals collected via optical emission spectroscopy (OES) to improve the signal sensitivity for EPD. K-means clustering (KMC), gaussian mixture model (GMM), and spectral clustering (SC) were applied and compared sensitivity enhancement of each method through signal to noise ratio. For all multivariate methods, signal sensitivites were at least doubled compared to OES single wavelength signal. The GMM showed the highest signal sensitivity improvement by 6.3 times, and SC and KMC improved by 4.6 times and 2.9 times, respectively. Also, discrete wavelet transform (DWT) filter and selective wavelength filter increased the sensitivity enhancement effect of modied clustering methods more than about 3 times and 2 times respectively.