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Virtual Metrology for predicting SiO_2 Etch Rate Using Optical Emission Spectroscopy Data

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A few years ago, for maintaining high stability and production yield of production equipment in a semiconductor fab, on-line monitoring of wafers is required, so that semiconductor manufacturers are investigating a software based process controlling scheme known as virtual metrology (VM). As semiconductor technology develops, the cost of fabrication tool/facility has reached its budget limit, and reducing metrology cost can obviously help to keep semiconductor manufacturing cost. By virtue of prediction, VM enables wafer-level control (or even down to site level), reduces within-lot variability, and increases process capability, C_{pk}. In this research, we have practiced VM on SiO_2 etch rate with optical emission spectroscopy(OES) data acquired *in-situ* while the process parameters are simultaneously correlated. To build process model of SiO_2 via, we first performed a series of etch runs according to the statistically designed experiment, called design of experiments (DOE). OES data are automatically logged with etch rate, and some OES spectra that correlated with SiO_2 etch rate is selected. Once the feature of OES data is selected, the preprocessed OES spectra is then used for in-situ sensor based VM modeling. ICP-RIE using 薐 .56MHz, manufactured by Plasmart, Ltd. is employed in this experiment, and single fiber-optic attached for in-situ OES data acquisition. Before applying statistical feature selection, empirical feature selection of OES data is initially performed in order not to fall in a statistical misleading, which causes from random noise or large variation of insignificantly correlated responses with process itself. The accuracy of the proposed VM is still need to be developed in order to successfully replace the existing metrology, but it is no doubt that VM can support engineering decision of “go or not go” in the consecutive processing step.