TF-P063

Data Qualification of Optical Emission Spectroscopy Spectra in Resist/Nitride/Oxide Etch; Coupon vs. Whole Wafer Etching

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As the requirement in patterning geometry continuously shrinks down, the termination of etch process at the exact time became crucial for the success in nano patterning technology. By virtue of real-time optical emission spectroscopy (OES), etch end point detection (EPD) technique continuously develops; however, it also faced with difficulty in low open ratio etching, typically in self aligned contact (SAC) and one cylinder contact (OCS), because of very small amount of optical emission from by-product gas species in the bulk plasma glow discharge. In developing etching process, one may observe that coupon test is being performed. It consumes costs and time for preparing the patterned sample wafers every test in priority, so the coupon wafer test instead of the whole patterned wafer is beneficial for testing and developing etch process condition. We also can observe that etch open area is varied with the number of coupons on a dummy wafer. However, this can be a misleading in OES study. If the coupon wafer test are monitored using OES, we can conjecture the endpoint by experienced method, but considering by data, the materials for residual area by being etched open area are needed to consider. In this research, we compare and analysis the OES data for coupon wafer test results for monitoring about the conditions that the areas except the patterns on the coupon wafers for real-time process monitoring. In this research, we compared two cases, first one is etching the coupon wafers attached on the carrier wafer that is covered by the photoresist, and other case is etching the coupon wafers on the chuck. For comparing the emission intensity, we chose the four chemical species (SiF2, N2, CO, CN), and for comparing the etched profile, measured by scanning electron microscope (SEM). In addition, we adopted the Dynamic Time Warping (DTW) algorithm for analyzing the chose OES data patterns, and analysis the covariance and coefficient for statistical method. After the result, coupon wafers are over-etched for without carrier wafer groups, while with carrier wafer groups are under-etched. And the CN emission intensity has significant difference compare with OES raw data. Based on these results, it necessary to reasonable analysis of the OES data to adopt the pre-data processing and algorithms, and the result will influence the reliability for relation of coupon wafer test and whole wafer test.

Keywords: OES data qualification, Coupon test