Experimental and Numerical Analysis of Nanoscale Particle Created During PECVD of Amorphous Carbon Layer

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Particulatecontamination that can affect to the device yield were generated during PECVD process.In order to generate high yield, the analysis of nano-scale particlecontamination is an important factor in the semiconductor and display panelmanufacturing. Since those deposition methods are progressed mostly in a vacuum conditions,a particle beam mass spectrometer (PBMS) to understand the particle size and thenumber concentration distributed inside vacuum was installed to the PECVD reactorexhaust for contaminant particle monitoring. To improve the dry etch strengthof amorphous carbon layer (ACL) for hardmask applications, layers weredeposited under various condition changes such as the plasma power,carbonaceous gas flow rate, nitrogen and boron dopant flow rate. To identifythe contribution of flow conditions to the measured particle size distributions,numerical analysis for the particle flow from the deposition chamber to PBMS inletwas also progressed. From the results, larger particle sizes and highergenerated particle concentrations were observed for the deposition processes ofB-doped ACLs, whereas the N-doped ACL deposition process revealed smallerparticle sizes and lower particle concentrations. Numerical analysis shows thatthe trapped or escaped particle counts inside each parts are closely related withthe total gas flow rate by showing separated distribution between higher gasflow rate and lower gas flow rate.