Effect of Gas Injection in Inductively Coupled Plasma with Fluorocarbon Plasma using Computational Fluid Dynamic Simulation

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Uniformity of plasma etching is increasingly demanded to improve process quality for fine patterns on etching process. In this study, various combinations of gas injection schemes were characterized to control the etch rate uniformity. The effect of gas injection on gas flux uniformity and plasma density uniformity in Inductively Coupled Plasma was studied. Hexafluoro-1,3-butadiene (C4F6) was used to characterize the uniformity of fluorocarbon films on silicon substrates. Fluorocarbon deposition is known to affect etch selectivity significantly in high aspect ration silicon dioxide etching processes. Gas was injected through vertical, horizontal, and side injectors. The deposition rates and uniformity showed significant change with radio frequency power, pressure, gas flow rates and Ar inerts gas fraction. However, It is hard to find out each parameters' effect on plasma process. Computational Fluid Dynamics simulation can give solutions for the analysis of each parameter's contribution. In order to evalutate the plasma system with simulation, we compared simulation data with real experiments data. As a result, etching rate, and uniformity was controlled by changing the injector position.