Dry Etching of SiO_2 with C_2F_6 Plasma in an ICP Process: Numerical Study with a CFD Code

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Numerical study has been conducted on SiO2 dry etching using C2F6 plasma in an inductively coupled plasma (ICP) etcher. As a first step to design a run-to-run control system for the ICP etcher, the purpose of the study has been placed in investigating the effects of operating variables such as RF power, bias voltage, pressure, and gas flow rate on the etching states such as etch rate, uniformity, and anisotropy. A commercial CFD code called CFD- ACE/TOPO was used for plasma and feature scale simulation.

As is generally understood, the simulator also predicted that the oxide etch rate and uniformity are strongly dependent on the ion flux and energy, and the radical flux above the wafer surface. Within the concerned ranges of operating variables, the ion flux was observed to be most strongly affected by the RF power and chamber pressure and the ion energy was shown to be most strongly influenced by the bias voltage. The neutral flux was found to be affected by all the operating variables. The relationship between the operating variables and the etching state was mathematically modeled through linear regression for future run-to-run control system design.