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

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In plasma etching of SiO_2 layer, CF_4 or NF_3 gas has been exclusively used in micro-electronics manufacturing. Recently, there has emerged a new trend to replace CF_4 with higher C/F ratio gases such as C_2F_6. It is because the C_2F_6 plasma more easily produces protective fluorocarbon polymers on the photoresist layer than CF_4 and increases the selectivity of SiO_2 etching. In this research, numerical study has been conducted on SiO_2 dry etching using C_2F_6 plasma in an inductively coupled plasma (ICP) etcher, which is currently the most widely used plasma reactor for anisotropic etching. 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, gas flow rate etc on the plasma state and furthermore on the etch rate and uniformity. A commercial CFD code called CFD-ACE was used for plasma simulation and TOPO for feature scale simulation of SiO_2 etching. As a result, within the concerned ranges of operating variables, it was discovered that increasing RF power, bias voltage, and decreasing pressure enhance the etch rate. Lowering the RF power alone gives better performance in uniformity.