# Plasma etching of $SiO_2$perfluorinated and partially fluorinated fluoro ethers

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A high aspect ratio contact hole etching of dielectrics (e.g., $SiO_2$) is one of the key processes in the fabrication of ultra large scale integrated devices because of the rapid shrinkage of the design rule to the nanometer level. Perfluorocarbons (PFCs) such as $CF_4$ and $C_4F_8$ are widely used as etchant gases for contact hole etching. These PFCs, however, are considered tobe problematic from an environmental viewpoint because of their long atmospheric lifetimes and high global warming potentials (GWP). Several classes of environmentally benign chemistries have been examined as alternatives to PFCs. Among them, fluoro ethers (either perfluorinated or partiallyfluorinated) draw attractions because of their much lower GWPs compared to those of PFCs. Although several fluoro ethers have been tested and shown that they would be promising alternatives to PFCs for $SiO_2$ etching, their etch mechanisms are still not well understood. To predict and control the etchprofiles, it is essential to understand the dependence of etch rates on the angle between the incident ion and substrate surface.

In this study, the angular dependence of $SiO_2$ etch rates inheptafluoropropyl methyl ether and perfluoropropyl vinyl ether plasmas were investigated. The etch rates of $SiO_2$ at various angles were measured using a Faraday cage system. The etch mechanisms were studied by varying theion-incident angles and bias voltages.

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