SiO_2 etch characteristics and environmental impact of Ar/C_3F_6O and $Ar/C_4F_8/O_2$

Soo Gang Kim [1], Kyung Che Yang [1], Da In Sung [1], Ye Ji Shin [1], Hyun Woo Tak [1], Jun Ki Jang [1], and Geun Young Yeom [1]

[1]Sungkyunkwan Univ., Korea, Republic of

Perfluorocarbon (PFC) gases are generally used for the nanoscale etching in the semiconductor process.However, when PFC gases are released into the air, they are influential to environment due to their long life time and global warming effect. So in this study, SiO_2 etch characteristics and global warming effects of C_3F_6O gas chemistry with low global warming potential (GWP) were studied. And the results of C_3F_6O gas chemistry were compared with C_4F_8 gas chemistry which is one of the gases mainly used in the semiconductor processing. With Ar/C_3F_6O, the etch rates and etch selectivities of SiO_2 over amorphous carbon layer (ACL) as the hardmask were compared with Ar/C_4F_8/O2. Also using scanning electron microscope (SEM), the etch profiles such as bowing, narrowing, and necking effects were compared. The plasma characteristics during the etching with Ar/C_3F_6O and $Ar/C_4F_8/O_2$ gas mixture were investigated using an optical emission spectroscopy (OES). And the surface chemistries of the etched SiO_2 were observed using x-ray photo electron spectroscopy (XPS). The global warming effects were evaluated by calculating the million metric ton carbon equivalents (MMTCEs) from the volumetric concentrations of emitted by-product species and process gases using fourier transform infrared (FT-IR).

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