

Chlorine Plasma Interactions with Yttria and Alumina-Coated Chamber Walls

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Time-dependent behavior of chlorine inductively-coupled plasmas will be presented for Si etching, following NF_3 -Ar plasma cleaning of a chamber coated with Y_2O_3 . Optical emission intensities were recorded throughout the processes for Cl, O, F, Si, $\text{SiCl}_{x=1-3}$, SiF, and N_2 , as well as from added trace rare gases Xe and Ar for determination of number densities for selected species by actinometry. Initially fluorinated yttria surfaces are shown to have a relatively high probability for loss (“recombination”) of Cl through formation of both Cl_2 and SiCl_x . As etching proceeds, SiCl_x abstracts F from the surface and deposits Si and Cl, lowering of the heterogeneous recombination of Cl. The initially high recombination coefficient for Cl is explained by the weakening of the surface binding energy for Cl and SiCl_x at YF_x sites, due to the highly electronegative nature of F, allowing recombination reactions forming Cl_2 and SiCl_x to become energetically favorable. These findings will be compared and contrasted with those obtained in chlorine-plasma etching of Si in chambers with alumina-coated chamber walls.