

Effect of plasma uniformity on atomic layer etching in capacitively coupled plasma

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Abstract: With the development of microelectronics industry, atomic layer etching (ALE) increasingly plays an irreplaceable role in realizing higher precision control of etching. The plasma uniformity is critically important to semiconductor fabrication. Based on the atomic layer deposition, the effect of plasma uniformity on atomic layer etching of SiO₂ is studied. In the research, by coupling a fluid/MC model with a trenching model, we simulate the ALE cycle. Atomic layer etching divides the etching process into two main self-limited reactions. For the first step in an Ar/CF₄ plasma, fluorocarbon (CF_x) film is deposited by the CF_x radicals. The second step is about the Ar positive ion bombardment on the fluorocarbon (CF_x) layer in Ar plasma. Based on the two-dimensional fluid model coupled with ion MC model, the parameters of etching, for example the ion fluxes and neutral densities as well as ion energy distributions, are utilized to simulate the etching profiles in the trenching model. Our results show that the etching profiles, etching rate and the theoretical analysis for these results are presented. By systematically studying, when the size of reactor is fixed, we mainly predict size of the wafer that the etching profiles are relatively uniform.

Keywords: capacitively coupled plasma, atomic layer etching, plasma uniformity.