3D feature profile simulation based on realistic surface kinetic studies of silicon dioxide etch process in $C_4F_6/Ar/O_2$ plasmas

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Recently, one of the critical issues in the etching processes of the nanoscale devices is to achieve ultra-high deep contact hole without anomalous behaviors such as sidewall bowing, and twisting profile. To achieve this goal, the fluorocarbon gas have been used with numerous additives to optimize the reactant fluxes and obtain the ideal etch profiles. As an effort to address this issue, we have developed a 3D topography simulator using the level set algorithm based on new memory saving technique, which is suitable in the high aspect ratio contact hole etching. For this feature profile simulation, we performed a fluorocarbon plasma-surface kinetic modeling based on the experimental plasma diagnostic data for etching process under C4F6/O2/Ar plasmas. In this work, a polymer layer based surface kinetic model was proposed as considering material balance of deposition and etching through steady-state fluorocarbon layer. Finally, the surface kinetic modeling results showed good agreements with experimental data and could be used successfully for 3D etch profile simulations with consideration of polymer layer.