Advanced 3D feature profile simulation with a realistic plasma surface reaction model

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One of the emerging challenges with plasma etch process is to achieve the ideal ultra-high aspect ratio in semiconductor fabrication processes. It is expected that the semiconductor industry encounters more difficult status as the critical dimension is getting smaller up to few nm level. To address this issue, we have developed a 3D feature profile simulator named as K-SPEED by a plasma consortium in KOREA since 2009. This simulator consists of Zero-D bulk plasma simulator with plasma chemistry, 3D level set algorithm, ballistic transport module, and surface reaction. In this work, we developed a universal fluorocarbon plasma surface reaction model to capture the realistic plasma etch process, which can be applied to most of high aspect ratio contact hole plasma etch. The detailed surface reaction parameters could be extracted by the molecular dynamics simulation and experimental data. Finally, it will be demonstrated that the 3D feature profile simulation incorporated with the realistic plasma surface reaction model can explain or predict a number of the abnormal plasma etch behaviors.