3D Charge-up simulation coupled with realistic plasma surface reaction model in plasma etch process

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Current plasma etching technology emerges as one of the key bottleneck process due to the advent of next generation electronic devices such as 3D memory and FINFET in semiconductor industry. As the feature size in next generation devices continues to decrease up to few nm level, the charge-up issues during plasma etching is being recognized as one of main reasons for the abnormal plasma. To address these issues in this work, we developed a 3D charge-up model which could be incorporated into 3D feature profile simulator named as K-SPEED. Furthermore, the realistic plasma surface reaction model of SiO2 plasma etching was strongly coupled with this charge-up simulation using 3D topography simulator. In our surface reaction model, the plasma etch under the existence of the steady state passivation layer was considered with both a semi-analytical model of passivation layer and detailed kinetic models of plasma deposition and etching. Meanwhile, charge-up simulation was composed of ion transport module and 3D Poisson equation. Finally, we demonstrated that this work can explain the unveiled physicochemical behavior related to the charge-up effects during plasma etching of nanoscale feature.