Abstract Submitted
for the GEC19 Meeting of
The American Physical Society

Pattern Dependent Profile Distortion in High Aspect Ratio Plasma Etching of SiO_2 and SiO_2-Si_3N_4-SiO_2 Stacks[1] SHUO HUANG, U. Michigan, SANG KI NAM, SEUNGBO SHIM, Samsung Electronics Co., MARK J. KUSHNER, U. Michigan — Transferring sub-10 nm microelectronics patterns using plasma etching into underlying materials is challenging due to feature distortions such as twisting, tilting and edge roughening. These distortions are attributed charging, polymer deposition and pattern dependencies. Randomness in distortions result from disparities in the fluxes of etching species into adjacent features, exacerbated in high aspect ratio (HAR) features due to conduction limits In this paper, we report on results from computational investigations of feature distortion during plasma etching of symmetric and asymmetric patterns in SiO_2 and SiO_2-Si_3N_4-SiO_2 (ONO) stacks using the 3-dimensional Monte Carlo Feature Profile Model. Reactive fluxes to the substrate are produced by reactor scale modeling using the HPEM. Feature-to-feature variations mainly result from stochastic variations in energy, angle and sequence of incident species. With symmetric patterns, charging of the surfaces of HAR features results in tilting of features in random directions. With identical bounding features, electrical forces on ions inside features should cancel though statistical variations produce net forces. With asymmetric patterns, charging produces tilting pointing from dense to sparse areas of the pattern due to net horizontal electric fields which deviate ion trajectories. The tilting can be lessened by increasing bias power, which elevates ion energy and decreases etch time, resulting in less charging.

[1]Work supported by Samsung Electronics, DOE Fusion Energy Sci.

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Date submitted: 29 May 2019 Electronic form version 1.4