Abstract Submitted
for the GEC10 Meeting of
The American Physical Society

3-dimentional atomics-scale cellular model and feature profile evolution during Si etching in chlorine-based plasmas: Analysis of profile anomalies and surface roughness HIROTAKA TSUDA, Kyoto University, HIROKI MIYATA, YOSHINORI TAKAO, KOJI ERIGUCHI, KOUICHI ONO — This paper focuses on the formation mechanisms of profile anomalies such as microtrench and surface roughness during plasma etching, by using our new semi-empirical 3-dimentional atomic-scale cellular model (ASCeM-3D) and feature profile simulation based on the Monte Carlo algorithm. The ASCeM-3D model represents Si trenches being etched in chlorine-based plasmas. The simulation domain is divided into a number of small square cells of atomic size of 2.7 Å, corresponding to the interatomic distance in Si substrates. The ASCeM-3D model takes into account surface chemistries based on the Monte Carlo algorithm, including physical sputtering, ion-enhanced etching, chemical etching, reemission of neutrals, deposition of etch products and by-products, and sputtering of deposited layers and oxidized surfaces. The ASCeM-3D also includes two-body elastic collision processes between energetic ions and Si substrate atoms, to simulate the ion penetration into substrates and the ion scattering from feature surfaces on incidence. By comparing the numerical and experimental results, we analyze the structure of nanometer-scale surface roughness and discuss plasma-surface interactions that cause profile anomalies and surface roughness.

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Date submitted: 11 Jun 2010 Electronic form version 1.4