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Formation Mechanisms of Surface Roughening and Rippling during Plasma Etching and Sputtering of Silicon HIROTAKA TSUDA, YOSHINORI TAKAO, KOJI ERIGUCHI, KOUICHI ONO, Department of Aeronautics and Astronautics, Graduate School of Engineering, Kyoto University — For the prediction of the atomic-scale surface roughness on feature bottom and sidewalls, we have developed our own three-dimensional atomic-scale cellular model (ASCeM-3D) and feature profile simulation. In this study, emphasis is placed on a better understanding of the formation mechanisms of nanoscale surface roughening and rippling during plasma etching and sputtering of Si with different ion incidence angles and ion incident energies. Numerical results indicated that surfaces are randomly roughened in the case of Cl_2 plasma etching for normal incidence of ions. For increased incident angles, ripples are formed perpendicular to the direction of ion incidence, while parallel to that of ion incidence for further increased incident angle. Numerical results also implied that the spatial dispersion of ion scattering and focusing on etched surfaces triggers the local difference in etch yield, and leads to the surface roughening and rippling during plasma etching and sputtering.

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