Literature Digest
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Plasma Etching

"Silicon-Oxide Etching Process Employing an Electron-Beam-Exited Plasma"
M. Ito, K. Takeda, T. Shiina, Y. Okamura, H. Nagai, M. Hori, T. Goto
J. Vac. Sci. Technol. B 22 (2004) 543

Silicon oxide is being etched with a CF_4/Ar mixture using the selfbias induced by an electron beam with a current of about 9 A.The highest etch rate of 117 nm/min was observed for a flow rate ration CF_4/Ar of 13 % at 0.18 Pa and electron acceleration voltages above 60 V.

"Effect of Thin-Film Imaging on Line Edge Roughness Transfer to Underlayers During Etch Processes"
D. L. Goldfarb, A. P. Mahorowala, G. M. Gallatin, K. E. Petrillo, K. Temple, M. Angelopoulos, S. Rasgon, H. H. Sawin, S. D. Allen, M. C. Lawson, R. W. Kwong
J. Vac. Sci. Technol. B 22 (2004) 647

In this work, atomic force microscopy (AFM) is used to investigate the contribution of the imaging resist sidewall topography to the sidewall roughness of the underlying features. The following 193 resists were investigated:
Single layer resists:
- cyclo-olefin-maleic anhydride based resin or methyl adamantane acrylate-co-lactone acrylate resin

Bi-layer resist:
- silane containing norborene-maleic anhydride terpolymer with a styrene-acrylate copolymer underlayer

The results show that the original topography of the resist is being lost and new spatial domains are being created. These new features can be attributed to the plasma / resist interaction but detailed explanations are not available. The best sidewall roughness performance was found for a 193 nm bi-layer resist scheme. Interestingly, not much difference was found between 248 nm and 193 nm single layer resists.

"Ion Bombardment Energy Control for Selective Flourocarbon Plasma Etching of Organosilicate Glass"
R. Silapunt, A. E. Wendt, K. Kirmse, L. P. Losey
J. Vac. Sci. Technol. B 22 (2004) 826

This paper reports on using tailored voltage wave forms to manipulate the ion energy distribution of an etching plasma to enhance etch selectivities for materials which are relevant for IC backend processing: organosilicate glass as the dielectric insulator and silicon nitride and silicon carbide as etch stop layers. The tailored forms are generated via a arbitrary wave form generator and a broadband amplifier. They consist of intervals with a steady substrate bias superimposed by relatively sharp peaks. While the IED's are not shown in the present paper, it is assumed that they are almost monoenergetic (at 1150 W of helicon power and a pressure of 15 mTorr) while the IED's for the sinusoidal wave forms should be distinctively bi-modal. The etch rates and fluorocarbon polymer film deposition rates were measured for C_4F_8 / N_2 / Ar mixtures with He addition from the He backside cooling system. In all case, the use of tailored wave forms shifted the onset of etching towards higher bias voltages with distinct differences in the magnitude for the different materials. As a result, potentially infinite selectivities for OSG over Si_3N_4 and SiC can be obtained. In contrast, selectivities of less than 2.5 were reported for the sinusoidal wave form. An analysis of the deposition and etch rates of fluorocarbon polymer films suggests, that the

underlaying mechanism is related to the details of the formation of the inhibitor layer rather than purely an etch threshold effect.

Transformer Coupled Plasma Etching of 3C-SiC Films Using Fluorinated Chemistry for Micromechanical Systems Applications"
D. Gao, M. B. J. Wijesundara, C. Carraro, R. T. Howe, R. Maboudian
J. Vac. Sci. Technol. B 22 (2004) 513

This paper reports on oxide hardmask etching SiC in a SF_6 / O_2 plasma. While the SiC etch rates are constant for 0 to 50 % oxygen addition, the mask selectivity increases due to a nearly linear decrease in the oxide etch rate. A selectivity of 2.6 SiC/PEO is reported for 50 % oxygen addition. For more than 50 % oxygen, the SiC etch rate starts to drop. The profiles are strongly tapered and seem to become more vertical for higher oxygen flows. AFM measurements indicate that the surface roughness decreases for longer etch times (50% oxygen addition).