Abstract Submitted
for the GEC05 Meeting of
The American Physical Society

SiO_2 and Si_3N_4 Etch Mechanisms in NF_3/C_2H_4 Plasma[1] PUTHAJAT MACHIMA, NOAH HERSHKOWITZ, Department of Engineering Physics, University of Wisconsin-Madison — Low-pressure inductive plasma was used to study SiO_2 and Si_3N_4 etching with the NF_3/C_2H_4 chemistry. NF_3 and C_2H_4 were used so that fluorine and carbon could be supplied from feed gases other than global warming fluorocarbons. Etch rates of SiO_2 over a wide range of conditions are less than 0.8 times the Si_3N_4 etch rates. Ex-situ XPS was used to determine the characteristics of a very thin steady-state film, to establish etch mechanisms. XPS results show that CH_xF, CF_2, and CF_3 were produced but in small concentrations compared to CH_x and CN. Mass spectrometry and optical emission gave consistent results. C1s spectra from etched oxide samples show a large percentage of H_xC-CH_x structures. Si_3N_4 appears to react easily with H_xC-CH_x structures, yielding CN-bearing products and SiC. Etch rate and selectivity results of NF_3-based discharges fed with C_2H_2, C_4H_{10}, and CH_3F are similar to the NF_3/C_2H_4 plasma. Comparisons of normalized F1s spectra of nitride and oxide etched under the same conditions show that relative concentrations of CF_2 and CF_3 on SiO_2 are much lower than the concentrations on Si_3N_4. It appears that SiO_2 preferentially reacts with only CF_2 and CF_3 but not with H_xC-CH_x or CH_xF. Differences in the abilities of SiO_2 and Si_3N_4 to react with H_xC-CH_x contributed to higher etch rates of Si_3N_4. Effects of bias frequency are presented.

[1]Work Supported by US EPA Grant No. RD-83145901-0

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Date submitted: 13 Jun 2005 Electronic form version 1.4