Abstract Submitted
for the GEC08 Meeting of
The American Physical Society

Threshold energy for plasma etching of high-k dielectric HfO_2 films in BCl_3-containing plasmas YOSHINORI UEDA, KEISUKE NAKAMURA, HIROAKI KIYOKAMI, HIROAKI OHTA, KOJI ERIGUCHI, KOUICHI ONO, Kyoto University — Plasma etching of high dielectric constant (k) materials is indispensable for fabricating of future high performance ULSIs. This paper presents the dependence of HfO_2 etch rate on incident ion energy onto a wafer stage, with emphasis being placed on the threshold energy for HfO_2 etching in BCl_3-containing plasmas. Experiments were performed in both an electron cyclotron resonance (ECR) and an inductively coupled plasma (ICP) reactor by varying the rf bias power, indicating that the threshold in pure BCl_3 plasma was E_{th} ≈5-14 eV, which is lower than the known E_{th} ≈26 eV previously reported. In addition, the threshold was further lowered by adding O_2 to BCl_3, where the HfO_2 etch rate was found to increase more significantly with increasing substrate temperature. These imply that the etching was chemically enhanced by O_2 addition to lower the threshold, probably because a small amount of added O_2 reduced the concentration of surface inhibitor species BCl_x and increased the concentration of atomic reactant Cl in the plasma [e.g., $2BCl_2 + O \rightarrow BOCl + BCl + 2Cl$]. We also investigated reactant and product species therein by using optical emission spectroscopy and quadrupole mass spectrometry, to discuss the etching mechanisms responsible for HfO_2 etching and their differences in ECR and ICP.

Yoshinori Ueda
Kyoto University

Date submitted: 13 Jun 2008 Electronic form version 1.4