Dry Etching of Al_2O_3 Thin Film in Inductively Coupled Plasma

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Abstract : Due to the scaling down of the dielectrics thickness, the leakage currents arising from electron tunneling through the dielectrics has become the major technical barrier. Thus, much works has focused on the development of high k dielectrics in both cases of memories and CMOS fields. Among the high-k materials, Al_2O_3 considered as good candidate has been attracting much attentions, which own some good properties as high dielectric constant k value (~9), a high bandgap (~2eV) and elevated crystallization temperature, etc. Due to the easy control of ion energy and flux, low ownership and simple structure of the inductively coupled plasma (ICP), we chose it for high-density plasma in our study. And the $BCl_3$was included in the gas due to the effective extraction of oxygen in the form of BClxOy compound.

In this study, the etch characteristic of ALD deposited Al_2O_3 thin film was investigated in BCl_3/N_2 plasma. The experiment were performed by comparing etch rates and selectivity of Al_2O_3 over SiO_2 as functions of the input plasma parameters such as gas mixing ratio, DC-bias voltage and RF power and process pressure. The maximum etch rate was obtained under 15 mTorr process perssure, 700 W RF power, BCl_3 (6 sccm)/N_2(14 sccm) plasma, and the highest etch selectivity was 1.9. We used the x-ray photoelectron spectroscopy (XPS) to investigate the chemical reactions on the etched surface. The Auger electron spectroscopy (AES) was used for elemental analysis of etched surface.

Key Words : Al_2O_3, Dry Etching; ICP; BCl_3/N_2