TENSILE BEHAVIOR OF AMORPHOUS ALUMINA THIN-FILMS DEPOSITED BY PLASMA ENHANCED ATOMIC LAYER DEPOSITION (PEALD)

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Amorphous structure aluminum oxide (Al_2O_3) films are used for various applications such as gas- and moisture-diffusion barriers. Al_2O_3 films deposited by atomic layer deposition (ALD) have good step coverage, high density and low surface roughness. However, these films contain more impurities and need longer processing time at lower growth temperatures. Plasma-enhanced ALD (PEALD) using trimethylaluminum (TMA) and O2 plasma was less dependent on temperature than thermal ALD. In this study, Al_2O_3 films were deposited by PEALD at low temperature (<100℃).

By Griffith's theory, the fracture strength of brittle materials reaches a theoretical strength at a critical thickness. Also, amorphous materials have plastic deformation when exposed to electron beam in TEM, as reported by several authors. We look at the critical thickness of amorphous Al_2O_3 films, which are brittle materials, and the changes in the mechanical behavior of amorphous Al_2O_3 ultra-thin film in SEM. The push-to-pull in-situ tensile test was used here to measure mechanical properties of ultra-thin films. For sample preparation, Al_2O_3 films were deposited using ALD and thin-films were fabricated with dog-bone shape using focused ion beam (FIB).