566b Atomic Layer Deposition and Film Characterization of Aluminum Oxide Grown on Si Using Tris(Diethylamino)Aluminum Precursor and Water

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Future scaling of transistor devices requires replacement of current gate dielectric material silicon dioxide by higher dielectric constant materials. Among the potential replacement materials, aluminum oxide has gained considerable interest. Aluminum oxide has many favorable properties like high band gap, thermal stability on Si, and amorphous structure at high annealing temperatures. However, its relatively low dielectric constant (~ 9) makes it only a short-term replacement. To improve dielectric constant and still maintain other useful properties of aluminum oxide, mixtures of aluminum oxide with other metal oxides having much higher dielectric strength such as hafnium oxide or zirconium oxide offers a more promising, longer term replacement for the silicon dioxide gate dielectric film. In this study, we investigate the self limiting kinetics of atomic layer deposition of alumina using tris(diethylamino)aluminum[1] precursor and water. Deposition rates against various reaction parameters like substrate temperature, reactants and purge pulses will be presented. After deposition, some of the resulting alumina films are annealed at 600 - 1000°C. Both deposition film and its interfacial region of annealed and non-annealed sample substrates are characterized using Fourier Transformed InfraRed spectroscopy, X-ray Photoelectron Spectroscopy, and Energy Dispersive X-ray (EDX) analysis. EDX analyses reveal near stoichiometric film composition along with below detection-level carbon in the films.

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