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A Multiple Internal Reflection FTIR Study of the Atomic Layer Deposition of Al_2O_3

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Al_2O_3, an attractive dielectric material due to its large band gap and large band offsets with respect to Si, is probably one of the most extensively studied materials. In ALD processes, it is important to understand the growth mechanisms of the surface species for their applications to nm-scale thin films. Surface vibrational spectroscopy has gained wide recognition for its ability to determine the chemical nature of surfaces and adsorbates. Especially, the IR spectroscopy using the multiple internal reflection (MIR) and single reflection modes is employed to obtain information on the reaction mechanism and the state of the interfacial layer between the substrate and the film. The high sensitivity of multiple internal reflection method to surface-bound species could lead to investigation of the mechanism of the Al_2O_3 growth reaction, particularly when a new precurosor is employed. In this study, the initial ALD growth mechanisms of Al_2O_3 thin films (employing dimethylaluminum isopropoxide, Me_2AlO^iPr, and water) on Si(001) and Ge(001) surfaces were explored by the MIR FTIR spectroscopy and the results were interpreted with calculated IR spectra.