MeV-Ion Beam Analysis of Atomic Layer-Deposition Ultra-Thin Oxide Films

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Ultra-thin aluminum oxide (Al_2O_3) film is currently being explored as a high dielectric constant gate dielectric for the next generation CMOS and related devices. Among many methods to produce such a film, atomic layer deposition (ALD) is a very attractive technique in the sense that it enables deposition of ultra-thin layers on the substrate with monolayer control. In this work, the Al_2O_3 film was deposited using ALD technique on a single crystalline silicon (100) substrate with a plasma grown silicon dioxide (SiO_2) layer sandwiched in between as a buffer interface. The total oxide layered structure was characterized by Rutherford backscattering spectrometry (RBS) in the channeling mode with MeV He^{2+}-ions as the analyzing probe. The RBS/channeling analysis detects O, Al and Si atoms in the ultra-thin oxide layers with clear separation from their Si substrate. Our evaluation was compared with results obtained by other standard technique, such as x-ray photoelectron spectroscopy (XPS).

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