A-15

Non-saturated Atomic Layer Deposition for Composition Adjustment in Al_2O_3-HfO_2 Thin Films

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Non-saturated atomic layer deposition (ALD) was investigated to achieve composition adjustment in multi-component thin films. This method controlled the composition using variations in the precursor injection time rather than variation in the cycle ratios. An adsorption rate constant was introduced to evaluate precursor adsorption with time. The composition in non-saturated ALD was calculated using an ALD film growth model with experimentally extracted parameters. This method was applied to Al_2O_3-HfO_2 thin films for validation. As a result, Al_2O_3-HfO_2 thin film was successfully deposited as a nano-mixed structure using non-saturated ALD despite a large compositional difference.

Keywords: ALD modeling, Al2O3-HfO2

A-16

Thermal Stability of Ruthenium and Iridium Thin Films Prepared by Atomic Layer Deposition

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Ruthenium (Ru) and iridium (Ir) films were deposited by atomic layer deposition (ALD) as a metal electrode for dynamic random access memory (DRAM) capacitor. Bis(ethylcyclopentadienyl)ruthenium [$Ru(EtCp)_2$] and (ethylcyclopentadienyl)(1,5-cyclooctadien)iridium [Ir(EtCp)(COD)] were used as metal precursors, and oxygen (O_2) gas was used as a reactant gas in both films. To confirm thermal stability of the films, high temperature annealing was performed in argon (Ar) and O_2 ambient using rapid thermal annealing (RTA) system. While both Ru and Ir films remained stable after annealing in Ar ambient, surface roughening of the films was occurred in O_2 ambient due to surface oxidation as annealing temperature was increased. Surface of Ir was much smoother than that of Ru because oxidation resistance of Ir is stronger than that of Ru and this result means that Ir is more suitable material for DRAM capacitor electrode.

Keywords: ruthenium, iridium, atomic layer deposition