

Investigation of Change of LaAlO₃/Si Structure after Thermal Treatment

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High dielectric constant materials (high-K), such as Al₂O₃, HfO₂, HfSiO, ZrO₂, La₂O₃, LaAlO₃ etc., have attracted a great deal of interest because of the dramatic scaling down of Metal-Oxide-Semiconductor field effect transistor (MOSFET) device reaching its physical limit in terms of reduction of thickness. LaAlO₃ is promising as a gate dielectric film in future CMOS devices because it has a large band gap (~6.2eV), high dielectric constant (24~27), small lattice miss match with Si (< 3%).

Alternating layer of thin La₂O₃ and Al₂O₃ films deposited on p-type Si wafer to form a nanolaminate film. La₂O₃ layer was deposited using tris(isopropyl-cyclopentadienyl)lanthanum [La(iPrCp)₃] and water by cyclic chemical vapor deposition and Al₂O₃ layer was deposited using trimethylaluminum (TMA) and water by Atomic Layer Deposition (ALD). The Si wafer surfaces were removed by HF-dipping immediately before film growth. Post-annealing of the samples was performed by Rapid Thermal Annealing (RTA) at 800°C for 30 sec under N₂ atmosphere. After RTA the Al atoms in the LaAlO₃ films diffused up to the film surface because the La-Silicate layer was formed at interface. Therefore to preserve uniform LaAlO₃ films, it is necessary to suppress the silicate formation caused by Si diffusion from substrate.