

Electrical properties of Zr-doped TiO₂ thin films for DRAM capacitors

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TiO₂ is one of the most promising materials for high dielectric thin film because it has an exceptionally high-k value. (anatase: 30-40, rutile: 90-170) But, the crystalline TiO₂ film has poor leakage current characteristics for dynamic random access memory capacitor.

In this work, we made the rutile TiO₂ thin film on RuO₂ substrate using atomic layer deposition because the RuO₂ has an almost identical lattice distance in the rutile crystal structure to that of the rutile TiO₂. And, we can solve poor leakage current characteristics by Zr-doping in the TiO₂ thin film.

After post-annealing of 20 nm thick TiO₂ film at 400 °C, the dielectric constant and the leakage current density were estimated to be ~60 and ~10⁻⁵ A/cm², respectively.

For the reduction of the leakage current density, a small amount of Zr was doped into TiO₂ film. The chemical composition of the Zr-doped TiO₂ thin films was confirmed to be Zr_{0.5}Ti_{4.5}O₁₀ by taking depth profiles of AES peaks. After post-annealing of the Zr-doped TiO₂ thin films, dielectric constants decreased to ~40 and the leakage current densities decreased ~10⁻⁵ A/cm².