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Electrical and structural investigation of Nd-doped TiO_2 thin films grown on RuO_2 substrate by Atomic Layer Deposition

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Nd-doped TiO_2 thin films were grown on the RuO_2 substrate at 225 ℃ by atomic layer deposition (ALD) technique using titanium(IV) isopropoxide [$Ti(OCH(CH_3)_2)_4$], Tris(2,2,6,6-tetra-methyl-heptanedionato) Neodymium(III) [$Nd(TMHD)_3$] and H_2O as precursors. The structural and electrical properties of Nd-doped TiO_2 thin films were investigated by TEM, AES, XRD, I-V and C-V measurements.

The dielectric constant and the leakage current density of the as-grown 20 nm thick TiO_2 film were estimated to be ~30 and 10^{-3}~10^{-4} A/cm^2, respectively. After post-annealing at temperatures higher than 400 ℃, higher dielectric constant of 60-80 was obtained while the leakage current value remained the same. For the reduction of the leakage current density, a small amount of Nd was doped into TiO_2 film. The chemical composition of the Nd-doped TiO_2 thin films was confirmed to be $Nd_{0.5}Ti_{4.5}O_{10}$ by taking depth profiles of AES peaks. After post-annealing of the Nd-doped TiO_2 thin films, both the dielectric constant and the leakage current density decreased from those of TiO_2 films. We will discuss the effect of Nd-doping on the electrical properties of the high-k TiO_2 films.