Effect of deposition temperature on the ferroelectric properties of Y-doped HfO_2 thin film prepared by medium-frequency reactive magnetron co-sputtering

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The crystal structureas well as electrical properties of sputtering deposited Y-doped HfO_2 thin films were investigated. Yttrium was incorporated into the HfO_2layer by co-sputtering of Y and Hf metal targets under argon/oxygen atmosphere.The 10 nm-thick HfO_2 thin film with 1.5 at.% yttrium-doping deposited at 200 ? and annealed at 850 ? for 40 s in nitrogen ambient shows excellent ferro-electricity with a large remnant polarization (Pr~20μC/cm^2) and low leakage current density (about 10^{-6} A/cm^2at 1MV/cm). The crystal structure and electrical properties of Y-doped HfO_2 thin films exhibit strong temperature dependence. We observed an enhanced suppression of ferroelectric phase (orthorhombic phase) fraction in favor ofthe para-electric phase (monoclinic phase) with increasing deposition temperature by the combination of grazing incidence X-ray diffraction (GIXRD) and high resolution transmission electron microscopy (HRTEM). A correlation of decreasing P_r and larger leakage current densities with the increasing deposition temperature in TiN/Y-doped HfO_2/Si stacks are shown in polarization and current density characteristics. The origin of the degradation of the ferro-electricity of Y-doped HfO_2 films deposited at higher temperature was attributed to the formation of m-phase which was unfavorable for inducing transition to the FE o-phase during after wardannealing.