The Growth and Structural Characteristics of Orthorhombic-phase Dominating Epitaxial Strained $Hf_{0.5}Zr_{0.5}O_2$ Ultra-thin Films by Pulsed Laser Deposition

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Abstract

$Hf_{0.5}Zr_{0.5}O_2$ (HZO) thin films has potential application in memory devices due to its ferroelectricity, which is believed to be originated from the non-centrosymmetric orthorhombic phase. Nevertheless, monoclinic phase is the most stable one at ambient condition. In this report epitaxial strained HZO layers with ultra-thin thickness were deposited on YSZ(100) substrate to achieve orthorhombic phase dominating layers. Detailed X-ray scattering measurements were conducted to characterize the structure of the layers. The deposited HZO films were confirmed to be monoclinic phase dominating with multi-domain texture for those of thickness larger than ~10 nm. As the thickness of HZO layers reduced to ~10 nm or less, we found the dominating phase of the HZO layers transfers to orthorhombic phase as judged by the distinct selection rules associated with different phases. To examine the electric properties of the HZO layers, a layer of Sn-doped In_2O_3 (ITO) was deposited prior HZO growth as bottom electrode. XRD reciprocal space mapping (RSM) measurements of the off-normal reflections was conducted to verify the deposited ITO layers were epitaxial and coherently strained on YSZ(100) when the thickness is below ~50 nm. A Platinum layer are deposited by using Radio Frequency (RF) sputtering as the top electrode to obtain the Pt/HZO/ITO/YSZ(100) structure.

Keywords - HZO, ITO, XRD, PLD