Effect of Interface on the Structure and Ferro-electric Property of Y-doped HfO_2 Thin Films Prepared by Reactive Magnetron Co-Sputtering

Jun Xu [1], Yu Zhang [1], Da-Yu Zhou [1], Wen-Qi Lu [1], Hang-Hang Wang [1], and Chi Kyu Choi [2]

[1]Dalian University of Technology, China (P.R.C)

[2]Jeju National University, Korea, Republic of

10 nm-thick ferroelectric HfO_2films with 1.5 mol%yttrium-doping were fabricated by mid-frequency reactivemagnetron co-sputtering deposition on bare Si and underlying ultrathin Hfbuffer layer. Yttrium was incorporated into the HfO_2 films bysimultaneously sputtering from Y and Hf metal targets under oxygen/argonmixture atmosphere. The presence of a non-centrosymmetric orthorhombic phaseresponsible for ferroelectricity properties in yttrium-doped HfO_2 (Y:HfO_2)films after annealing treatment was established by high-resolution transmissionelectron microscopy and X-ray diffraction. The interfacial oxide layerstructure and electrical properties of Y:HfO_2films with and without Hf buffer layer were investigated. Effects ofinterfacial layer on the ferroelectric characteristics were studied accordingto the theory calculation and analysis of experiments. As an initial oxidationprotective layer, the ultra-thin Hf (~1nm) layer covers the silicon surface andprevents the initial silicon oxidation during the deposition and post-annealingprocess. A remnant polarization P_r of up to14 μC/cm^2 was obtained in Y:HfO_2 with Hf buffer layer. Itwas shown that the presence of Hf buffer layer not only improve the permittivitybut also essential for the ferroelectricy of Y-doped HfO_2 thin filmsdeposited by reactive magnetron sputtering.

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