Effects of La2O3 capping layers prepared by different ALD Lanthanum Precursors on Flatband Voltage Tuning and EOT scaling in TiN/HfO2/SiO2/Si MOS structures

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Abstract

The use of thin capping layers that are inserted between the gate metal and dielectric layers have been shown to simultaneously cause a negative flatband voltage (Vfb) shift and to stabilize low threshold voltage (VTH). A major challenge with capping layers is to achieve adequate effective work function shifts without large increases in equivalent oxide thickness (EOT) (DEOT). In this work, the effects of La2O3 cap layers prepared by different ALD Lanthanum precursors, La(fAMD)3 and La(thd)3, on flatband voltage tuning and EOT scaling in TiN/HfO2/SiO2/Si metal oxide semiconductor (MOS) structures was investigated. Experimental results showed that DVfb and DEOT as high as 0.45 V and 0.055 nm, caused by dipoles at the lower interface between HfO2 and SiO2 interlayer and the diffusion of La and Hf atoms to the SiO2 interlayer, were achieved by a 1 nm thick La2O3 capping layer using a La(fAMD)3 precursor, while a relatively smaller Vfb and EOT of 0.7 V and 1.27 nm were obtained from the noncap TiN/HfO2/SiO2/Si MOSCAP sample. The use of a La(fAMD)3 precursor for the La2O3 capping layer deposition has been shown being much superior to La(thd)3 due to lower atomic layer deposition (ALD) process temperature and shorter O3 oxidant pulse duration.

Keyword：La2O3, TiN, HfO2, ALD, MOS