Electrical and physical characteristics of MOCVD zirconium and hafnium silicate thin films using new combinations of precursors

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Although HfO_2 and ZrO_2 high-k materials as alternatives for conventional SiO_2 gate dielectric are promising candidates today, atomic oxygen (O) fast diffuses through these films. Thus interfacial layers are formed when depositing ZrO_2 and HfO_2 directly on Si, respectively. For these reasons silicates of zirconium (Zr) and hafnium (Hf) are promising dielectric materials with demonstrated thermal stability in direct contact with Si. Zr-silicate films were deposited by CVD using $Zr(NEt_2)_4$/$Si(OCH_3(CH_2)_3)_4$ precursors. $Hf(NEt_2)_4$/ $Si(OCH_3(CH_2)_3)_4$ precursors were used to grow Hf-silicate films. The permittivity of the films was about 8-17 at 8-30nm thickness. The film composition was confirmed by XPS and AES results. In high-resolution TEM images and FE-SEM images, Hf silicate-Si interface was seen to be atomically sharp, but Zr silicate-Si interface has very thin native oxide. The film was completely amorphous up to high temperature (800-900℃), which was confirmed by thin film-XRD. I-V and C-V curves of silicate films were measured from -4 V to 4V applied voltage with an Al electrode. supported by a grant No.(R01-2002-000-00279-0(2002)) from Korea Science & Engineering Foundation.