<< 수상기념 >>

ELECTRONIC AND OPTICAL PROPERTIES OF HIGH-K DIELECTRIC THIN FILMS

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The rapid downscale of dimension in complementary metal-oxide-semiconductor (CMOS) devices will call for replacement of SiO_2 with alternative high-k dielectrics owing to excessive tunneling current, dopant diffusion, and reliability problem in the near future. For advanced semiconductor devices application, HfO_2, ZrO_2, Hf and Zr silicates are the promising candidates for replacing the SiO_2 gate dielectric. Although they have higher dielectric permittivity and good thermal stability with the Si at higher temperatures, they tend to crystallize at relatively low temperatures during post-deposition annealing, and hence there is a definite need for further improvement. To get a clear insight into the electrical properties of thin high-k gate stack on Si, a better understanding for the electronic and optical properties of high-k dielectrics is necessary. In this work, the electronic and optical properties of ZrO_2, HfO_2, Hf silicate and Zr silicate thin films on Si(100) have been experimentally investigated by using reflection electron energy loss spectroscopy[REELS] and X-ray photoelectron spectroscopy [1-3].

The band gap was determined from the onset values of the energy loss spectrum, and the valence band offset values were obtained by using XPS spectra. The optical properties of high-k thin films have been determined by comparing the experimental cross section obtained from reflection electron energy loss spectroscopy with the theoretical inelastic scattering cross section, deduced from the simulated energy loss function (ELF) by using QUEELS-ε(k)-REELS software[3,4]. The optical properties, e.g., refraction index (n) and extinction coefficient (k) of high-k gate oxide thin films are discussed.

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