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Electronic and Optical Properties of Al_2O_3/SiO_2 Thin Films on Si Substrate

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Al_2O_3/SiO_2 thin films as gate dielectrics have been proposed to overcome the problems of tunneling current and degradation mobility in achieving a thin equivalent oxide thickness. An extremely thin SiO_2 layer is used in order to separate the carrier in MOSFET channel from the dielectric field fluctuation caused by phonons in the dielectric which decreases the carrier mobility. The electronic and optical properties influenced the device performance to a great extent. In this study, the band gap and the optical properties of Al_2O_3/SiO_2 thin films were obtained from the experimental inelastic scattering cross section of reflection electron energy loss spectroscopy (REELS) spectra. The bandgap of Al_2O_3/SiO_2 thin films slightly increases from 6.5 eV to 7.5 eV after annealing due to the bond structure change in of Al_2O_3/SiO_2. The optical properties, e.g., index refractive (n), extinction coefficient (k) and dielectric function (ε) were obtained from REELS spectra by using QUEELS-ε(k, ω)-REELS software shows good agreement with other results. The energy-dependent behaviors of reflection, absorption or transparency in Al_2O_3/SiO_2 thin films also have been determined from the optical properties.