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Electron capture kinetics at AlF_3/SiO_2 interfaces

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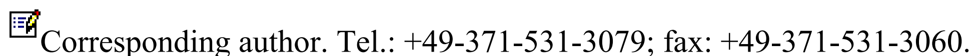
Abstract

Charge deep-level transient spectroscopy (Q-DLTS) was applied to study the mechanism of capturing electrons at the AlF_3/SiO_2 interfaces of AlF_3-coated oxidized p-type Si. The process may be viewed as comprising three consecutive steps: (i) formation of an inversion layer in p-Si; (ii) electron tunneling through the ultra-thin SiO_2 interlayer; and (iii) capture of electrons at F-vacancies in AlF_3 after surmounting a potential barrier E_b. A semi-empirical model of non-exponential kinetics of the charge transients has been developed and compared with experiment. Three discrete electron traps of a quasi-discrete spectrum of traps in AlF_3 could be resolved. The thermal activation energy of a Q-DLTS peak (0.6–0.7 eV) seems to reflect E_b, while the full-width at half-maximum (FWHM) corresponds to thermal activation of minority carriers over the band gap of p-Si (≈1.1 eV). Coulomb-blockade effects may be responsible for the temperature dependence of the capture cross-section $\sigma_n=\sigma_{n0}\exp(-E_b/kT)$.

Author Keywords: AlF_3; Electron states; Spectroscopy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