INVESTIGATION OF ELECTRON AND HOLE TUNNELING THROUGH THIN SILICON DIOXIDE FILMS

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The processes of electrons and holes tunneling through thin ($\sim$ 10 nm) silicon dioxide films have been investigated. In parallel with the direct measurement of tunneling current in Si–SiO_2–Al structures, an original method, based on the accumulation of charge in Si–SiO_2–Si_3N_4–Al structures, have been used. The current-voltage dependences obtained by two methods for electron tunneling are in agreement and correspond to carrier injection from silicon at a positive voltage on metal according to the Fowler – Nordheim mechanism. The hole tunneling current can be measured only by the charge accumulation method due to a high energy barrier for holes. Possible mechanisms of positive charge accumulation are discussed. The obtained values of the exponential in the dependence of the accumulation current on reverse field are equal to $7.5 \cdot 10^8$ and $6.8 \cdot 10^8$ V/cm, and are assumed to be due to tunnel injection. In this case, the estimations for the effective masses of holes in the forbidden band of SiO_2 of about $1.2m_0$ and $1.0m_0$ are obtained.