INFLUENCE OF INTRAPORE PRESSURE ON ELECTROPHYSICAL PROPERTIES OF POROUS SILICON

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S u m m a r y

The influence of internal pressure, which appears due to the formation of ice in pores of porous silicon (PS), on the physical characteristics of metal–PS-Si structures has been studied. The maximum of accumulation capacitance was observed in the temperature range $T = -4.0 \div 4.0$ °C. The nonmonotonic behavior of the capacitance is explained, first of all, by the increase of the intrapore pressure, when water becomes frozen in pores. Under the condition of the formation of an ice-like structure in pores with decrease in the temperature, the temperature behavior of the capacitance is also affected by both a jump-like reduction of the effective dielectric permittivity of the PS–ice system and the reconstruction of deep levels in the PS. The latter scenario was confirmed by the results of DLTS measurements of the capacitance relaxation curves of MIS structures with intrapore water in the vicinity of the ice-formation temperature. Making use of the Bruggeman effective medium approximation, the cylindrical pore model, and the approximation of isotropic extension of water, which was capillary adsorbed in pores, at its freezing, we, by analyzing the temperature dependences of the capacity-voltage characteristics, estimated the magnitude of local intrapore pressure, which turned out to be 7×10^9 Pa. Such pressure gives rise to a reduction of the bandgap in porous silicon by 0.16 eV and induces a corresponding shift of the activation energy of deep levels in a porous semiconductor.