FREQUENCY-DEPENDENT CONDUCTANCE AND CAPACITANCE OF THE SEMICONDUCTOR HOMOJUNCTION AND EVALUATION OF INTERFACE-STATES PARAMETERS IN p-Si/p-Si DIRECTLY BONDED STRUCTURES

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Within the framework of the thermoionic emission model of charge transport over the potential barrier and with allowance for the trapping of majority carriers at the bonded interface, the frequency-dependent small-signal complex conductivity of the unipolar semiconductor junction with interface states at the junction plane has been calculated. The consideration explicitly takes into account the effect due to relatively shallow interface states, which, although being almost empty and therefore not affecting significantly the electrostatics of the interfacial space-charge region, actively participate in the exchange with charge carriers with the allowed energy band. The final expressions for $G(V, \omega)$ and $C(V, \omega)$ include not only the energy density ν^* of interface states at the interfacial Fermi level, but are also determined, in principle, by the whole $\nu(E)$ distribution above the Fermi level. The derived formulas for the physical quantities of interest also take into account the fact that charge carriers, after their capture to and subsequent emission from the interface states, "forget" information about their previous motion.

General behavior of the $G(V, \omega)$ and $C(V, \omega)$ dependences is revealed. In accord with the experiment, at a fixed bias voltage the calculated capacitance C of a biased junction increases with increasing frequency compared to its "geometric" value observed in the high-frequency limit $\omega \to \infty$.

A short-cut calculation procedure is developed for evaluating interface-states parameters from capacitance and conductance data. Estimates obtained for real p-Si/p-Si directly bonded junctions are presented. Reasons for overestimated cross section of charge-carriers capture onto interface states are discussed. The obtained data provide an indication for substantial lateral non-uniformity of barrier height in these junctions.