Investigation of Ohmic Contacts to Silicon IMPATT Diodes

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The maximal output power of impact avalanche and transit time (IMPATT) diodes is related to the properties of *p-n* junction as well as thermal stability of ohmic contact. The investigations of 8 mm-wave IMPATT diodes showed [1] that no degradation of diode active region occurs at temperatures T below 350°C. Thus, to increase the IMPATT diode output power, it is necessary to develop and investigate heat-resistant multilayer ohmic contacts with low contact resistivity ρ_c that could remain stable at temperatures up to 350°C.

We studied ohmic contacts to two multilayer structures with Au-Ti-Pd metallization. The ohmic contacts were formed on n-n^+-Si with dopant (phosphorus) concentration in n^+-Si of about 10^{20} cm^{-3}. To this end, the layers of palladium (20 μm), titanium (60 μm) and gold were sequentially magnetron-deposited in a single technological cycle onto a silicon substrate (heated to $T = 350$°C) that was previously exposed to photonic cleaning. The gold layer thicknesses in two specimens studied were 0.1 μm and 1.1 μm, respectively. The Auger concentration depth profiles of contact components (taken before and after rapid thermal annealing at temperatures up to 350°C) indicated contact stability.

When studying a vertical Au-Ti-Pd-n-n^+-Si structure, contact resistivity $\rho_c = 1.3 \div 5 \times 10^{-5}$ Ω·cm^2 at $T = 300$ K was obtained. We propose a method for error minimization in calculation of contact resistivity in which the value of semiconductor resistivity determined for each template is replaced with the most probable resistivity value for the whole wafer in a case of negative correlation between the contact resistivity and semiconductor resistivity.

1. A.E. Belyaev, et al., *Semiconductors*, **45**(2), (2011), 253.