Devices Based on Silicon Carbide with a Quantum Structure

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The unique properties of silicon carbide, such as high hardness, chemical and radiation resistance, make it possible to use carbide devices in such operating conditions, where similar devices on silicon can not be used. High sensitivity to spectral plot 0.2-0.4 microns and its absence in the visible spectrum offers a unique opportunity to use Au-SiC photodiode structures in metrology of ultraviolet (UV) radiation.

In this paper, the effect of surface treatment on photoluminescence and photoelectric properties of single crystals 6H-SiC were investigated. As a result of chemical etching of silicon carbide crystals in the melt-mix $1KOH:(50\div100)NaNO_3$ microrelief in the form of a sphere-like grain diameter $0.5\div1.0$ microns or less formed on the surface $(000\bar{1})C$. To create a photosensitive Schottky diodes semitransparent gold contacts were deposited in vacuum 10^{-6} Torr on heated substrate by thermal evaporation. The thickness of the gold film was about 10 nm, which ensured its relatively high optical transparency with sufficient electrical conductivity. Ohmic contacts were formed by vacuum deposition of the same metal with following burning in with laser pulse (λ = 1,06 μm). The resulting devices had high stability and well-marked diode properties. Photosensitivity of Au-SiC diodes covers the spectral area 200-350 nm, with sensitivity considerably higher than the value of the sensitivity diodes that were created on the mirror surface for comparison. In the photoluminescence spectra of samples radiation with photon energies $\hbar\omega$, larger band gap 6H-SiC present. This can be explained by the dimensional quantization of energy carriers, which occurs as a result of the creation of microrelief on the surface of the semiconductor. In this case, the photon energy is determined by the formula

$$\hbar\omega = E_g + \Delta E = E_g + \frac{\pi^2\hbar^2}{2d^2}\left(\frac{1}{m_n^*} + \frac{1}{m_p^*}\right) \quad (1)$$

where m_n^* and m_p^* - the effective masses of electrons and holes respectively, and d - the size of nano-objects on the surface of the crystal. Substituting known values of constants and effective mass and the experimental data $\hbar\omega$ into (1) allows to obtain value d = 4 nm.