Optical Properties of Substrates with Surface GaP Quantum-Dimensional Structures

Makhniy V.P., Sklyarchuk V.M., Bodyul G.I., German I.I.

Yuri Fedkovych Chernivtsi National University, Chernivtsi, Ukraine

In spite of its indirection, gallium phosphide is still one of the basic materials for producing of sources and detectors of optical radiation, including not well mastered UV region. For example, commercially available metal-GaP photodiodes have detectability ~ 1014 W^{-1} $Hz^{1/2}$ cm in the range of 2.5-6.0 eV, as well as a higher temperature and a radiation resistance for comparison with the receivers based on Si. However, being actual , the search of technologies of producing the photosensitive diode structures that lead to significant reduction of dark currents and the surface recombination velocity. Perspective and promising in this regard may be GaP substrate modification in particular, by creating the surface quantum structures (PKRS) on them. The reason for this are the contacts metal-CdTe, the using of which like technology, helped increase significantly the efficiency of solar cells based on them. The present work is devoted to creating PKRS GaP substrates and studying its impact on their main optical characteristics. The starting substrates were single-crystal n-GaP wafers with a smooth surface which is characterized by the absence of visible photoluminescence (PL). Differential spectrum of the optical transmission T'_ω such samples submitted with a curve with a maximum at $\hbar\omega_m \approx$ 2,28 eV, which agrees with the bandgap E_g GaP at 300 K. Treatment of substrates in the melt mixture of NaOH + KNO3 leads to a matting surface and a significant change in their optical properties. First of all, we must notice the appearance of the luminescence whose spectrum contains photons with energy much larger E_g, curve 2. Such radiation is adequately explained by the quantum-well structure, which occurs on the surface of GaP substrates by treatment and usually consists of two types of nano-grains with lateral dimensions of 10 -30 nm and 100-300 nm . The first group of responsible for the formation of high-energy radiation, and the second - a low-energy "wing" prospectrum of the optical transmittance, curve 3. In addition, researches have shown that Ni- GaP contacts, made on modified substrates have a greater height of the barrier and quantum efficiency than similar structures fabricated on substrates with a smooth surface.