Nature of Edge Luminescence of α-ZnSe Heterolayers

Slyotov M.M., Gavaleshko O.S.

Yu.Fedkovych Chernivtsi National University, Chernivtsi, Ukraine

Zinc selenide is one of the most promising semiconductors for creation of radiation sources in the blue optical wavelengths. They are formed on the base of materials with cubic lattice modification (band gap $E_g \approx 2{,}7$ eV at 300 K). However, it remains small studied obtaining and investigation of hexagonal zinc selenide properties, and especially its layers as active region of functional electronics devices.

α-ZnSe heterolayers formed by isovalent substitution method due to α-CdSe crystals annealing in saturated pair of Zn. On the surface of the substrate with black color the compound formed with yellow-green color appropriate to ZnSe. By means of λ-modulation method the optical reflection (OR) and photoluminescence (PL) were studied. Differential OR curves consists of three peaks corresponding for the optical processes in materials with a hexagonal lattice. This spectrum allowed to determine the band gap of α-ZnSe $E_g = 2{,}89$ eV, and the value of the valence band splitting due to spin-orbit interaction $\Delta_{so} = 0{,}37$ eV and crystal field $\Delta_{cr} = 0{,}07$ eV. Intense photoluminescence in the edge region inherent for the obtained α-ZnSe heterolayers with a maximum at photon energies $\hbar\omega = 2{,}7$ eV. The studies of differential spectra revealed two main components of radiation. The dominant band has the following properties: maximum displacement in the region of lower energies with increasing of excitation level L; the intensity I of L is in accordance with the law $I \sim L^{1,5}$. These basic properties with contour asymmetry and exponential dependence of the band edge intensity from the photons energy $\hbar\omega$ indicate the nature of the dominant exciton emission. Importantly, this emission is observed at 300 K. The second component of the radiation in the range $\hbar\omega > E_g$ is determined by the interband radiative recombination of free carriers. Note that transitions with participation of subzone split by crystal field Δ_{cr} are also observed in the luminescence spectra of α-ZnSe heterolayers. In general, an edge emission at 300 K indicates the possibility of using heterolayers in different types of functional electronics devices. What is important is stability in time of their properties. This caused by the peculiarities of heterolayers formation by means of isovalence replacement. They grow in "depth" of the matrix, and therefore determine the substrate lattice and stabilize the crystal structure of formed heterolayer. Possible inconsistency of crystalline and thermal parameters of contacting materials is compensated by corresponding graded-gap solid solution.