The Influence of Own Point Defects on Luminescence Of α-ZnSe Heterolayers

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Wide-gap II-VI-semiconductors are widely used in functional electronics. Among them the most interest is attracted by zinc selenide. As well know, the undoped β-ZnSe specially own point defects reveals themselves. They form different energy states that affect on material properties and behavior of impurity atoms in it, especially isovalent. Such information may be significantly supplemented by investigation of properties of hexagonal modification α-ZnSe layers, that's the main aim of this work.

Heterolayers of α-ZnSe were obtained by isovalent substitution method. The hexagonal structure of the grown layers is confirmed, in particular, undertaken studies of optical reflection of R_ω. On the differential curves R'_ω, obtained by using λ-modulation, characteristic of this type of crystal structure features were observed. They are caused by the band structure of the relevant parameters: $E_g = 2{,}89$ eV, $\Delta_{SO} = 0{,}37$ eV, $\Delta_{CR} = 0{,}07$ eV. Specially undoped heterolayers inherent luminescence in the photons energy $\hbar\omega < E_g$. It is characterized by the presence of three main components bands, which is marked by means of symbols A, B, C. They correspond to the energy centers with the ionization energy E_i at 0,06 eV, 0,135 eV and 0,583 eV, respectively. They are defined from the studies of temperature dependence of conductivity and luminescence. For the bands A and B are inherent peculiarities of small centers – maxima correspond $\hbar\omega_m = E_g - E_i$, and bands form adequately approximated by Gaussian distribution. The obtained values of E_i in a good agreement with the depth of singly charged vacancies of selenium $V^{\bullet}_{Se}$ and zinc V'_{Zn} in β-ZnSe (0,03 eV and 0,18 eV). We can assume that such own point defects (OPD) is also involved in the formation of α-ZnSe emission. The nature of C band with $E_i = 0{,}583$ eV is explained by recombination via deep levels in according to the model of Kopylova-Pihtina. This is evidenced by the following main features: asymmetric band shape, its large half-width (which increases with the excitation level L), and the independence of the $\hbar\omega_m$ with changes of L values. Under certain conditions on the differential curves of luminescence can be observed the equidistantly excesses with the interval of 21 meV, corresponding to the LO-phonon energy in α-ZnSe. Position of the C-band maximum at $\hbar\omega_m = 2{,}43$ eV corresponds to the following equation $E_i = E_g - \hbar\omega_m - \Delta$, where Δ – Frank-Condon shift. Calculations by the known expressions give $\Delta = 0{,}123$ eV, which is close to $\Delta = 0{,}2$ eV for β-ZnSe. The most likely explanation of the deep centers nature is that interstitial atoms of cations sublattice Zn_i, as in the case of β-ZnSe. Possible assumptions about the nature of these indicated OPD analyses by the method of quasichemical reactions.