RELAXATION PROCESSES IN QUANTUM-DIMENSIONAL STRUCTURES

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Abstract. *The emission spectra of deep levels of ZnSe/(001) GaAs epitaxial films with different thicknesses grown by the MPE method were determined by photoluminescence. ZnSe/(001) GaAs epitaxial films consist of three regions in terms of concentrations of other elements and defects. The energy shift of the bands indicates a decrease in the compression stress in the pit and the tensile stresses in the buffer layer. One of the ways to influence the characteristics of the A2B6/GaAs interface of structures is the use of thin intermediate layers, which can delay the processes of interdiffusion of film and substrate components.*

Keywords: *photoluminescence, photoreflections, quantum well, relaxation.*

РЕЛАКСАЦИОННЫЕ ПРОЦЕССЫ В КВАНТОВОМЕРНЫХ СТРУКТУРАХ

Аннотация. *Методом фотолюминесценции определены спектры излучения глубоких уровней эпитаксиальных пленок ZnSe/(001) GaAs различной толщины, выращенных методом МПЭ. Эпитаксиальные пленки ZnSe/(001) GaAs состоят из трех областей по концентрации других элементов и дефектов. Энергетический сдвиг полос свидетельствует об уменьшении напряжений сжатия в ямке и растягивающих напряжений в буферном слое. Одним из способов влияния на характеристики интерфейса структур A2B6/GaAs является использование тонких промежуточных слоев, которые могут задерживать процессы взаимной диффузии компонентов пленки и подложки.*

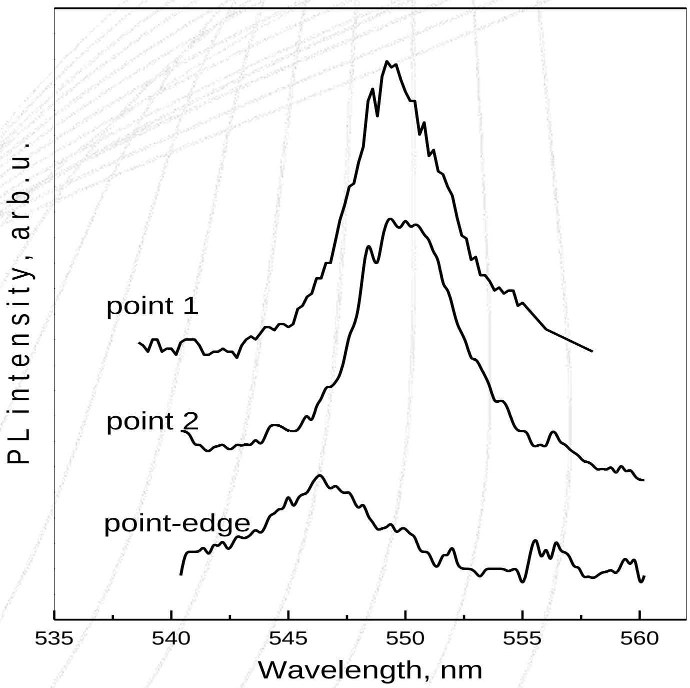
Ключевые слова: *фотолюминесценция, фотоотражения, квантовая яма, релаксация.*

The interest in the radiation of quantum-dimensional structures based on A2B6 materials is due to the possibility of manufacturing injection sources of coherent and incoherent radiation on their basis, as well as emitters with electron pumping 2, covering almost the entire visible range.

However, the implementation of this class of heterostructures faced the problem of degradation of their properties both during operation and during various heat treatments in the manufacture of devices. Deterioration of the quality of heteroepitaxial layers is usually associated with the multiplication of dislocations in active areas during operation of the device. The presence of mobile point defects against the background of relaxation processes can play an essential role in this case,

Measurements of the FL and reflection spectra (R( )) in the range from 1.4 to 2.4 eV were carried out in the temperature range from 4.2 to 80 K on an automated installation with lattice, and in the range of 0.6 -1.4 eV with prismatic monochromators. The PL spectra were excited by argon laser radiation with microns and microns. The influence of two types of radiation treatment of A2B6 structures: electrons and X-ray quanta has been studied. The temperature of the samples during irradiation did not exceed 60 ° C

Figure 1 shows the PL spectra of the initial sample with quantum-dimensional layers deposited on the buffer layer (curve 1) and after irradiation with X-ray quanta. In the energy range E_g = hν = E_g – 25 MeV, where Eg is the width of the ZnTe band gap (E_g = 2.37 eV, 77K), luminescence bands belonging to the buffer layer and associated with a free exciton split by a biaxial voltage into two components - I_{FX}^{hh} and I_{FX}^{lh} (I_{FX}^{hh} = 2.366 eV, 524 nm) and a band that is an overlap of the I_{FX}^{lh} band and the exciton band bound on the donor ($I_{FX}^{lh} = I_2^{Ga}$ = 2,3609 eV, 525.2 nm), polariton radiation is possible [3]. A parasitic resonantly amplified 7LO phonon is observed at excitation of λexc=4880 nm. In the energy range E_g ≤ 25 мэВ ≤ hν ≤ 2,3 эВ, a luminescence band dominating in intensity is observed, belonging to radiation from three tunnel-coupled wells and corresponding to the lowest-energy transition involving heavy holes 1hh - –I^{KW} = 2,319 eV, 534.8 nm) and sufficient.



- Fig. 1. PL spectra at 77 K (№.2-1) of the initial (curve 1) and (№.2-3) X-ray irradiated (curve 2) sample with three tunnel-coupled quantum wells. λ_{exc} = 0.488 microns, P_{exc} = 5 W/cm^2.

$$E_g\ [eV] = 1.508 - 1.214x + 0.264x^2. \quad (1)$$

Position of the first levels of dimensional quantization for electrons and heavy holes were numerically using the Schrödinger equation, which was solved in one-electron approximation within the envelope-wave function method. Effective Carrier Weights charges (electrons and heavy holes) were considered single-cow for all layers of the structure and equal to the corresponding values in the quantum well, calculated from ratios:

$$m^*_e = 0.0665 - 0.0642x,$$

$$m^*_{hh} = 0.62 - 0.22x. \quad (2).$$

- Therefore, the average value exciton bond energy of 7 meV to calculate all FL peaks are a good approximation.

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