RECOMBINATIONAL RADIATION IN DOPED CRYSTALS OF ZINC DIPHOSPHIDE

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In the case of semiconductors with an indirect energy gaps of interdicted zones of the type $ZnP_2\,(D_4^8)$ optical transition with absorption and emission of phonons are found in the free exiton zone. In the case of alloyed crystals those materials in a small mixture appear impurity states on which the bound exitons are located. With the contribution of bound exitons also happens the indirect transition with absorption and emission of phonons. This type of transition is found and is also examined in others semiconductors, as well as in crystals of GaP[1].The indirect transitions with absorption and emission of phonons can take place in the same time with the contribution of the same photons, in free exiton zone as well as the bound exciton zone. In this case collision and even the interference of absorption combined with the processes mentioned above take place [2].

The doping of tetragonal ZnP_2 crystals with antimony (0,5%) bring to the displacement of the absorption edge to the range of more wavelengths in a insignificant degree. The absorption on the bound exiton adjoins the interband absorption and the absorption on a free exiton. The indirect transition in a free exiton zone at 10^0K in $ZnP_2\,(D_4^8)$ is equal to 2,216eV. In the spectra of luminescence, which receive in case of excitation of the Ar^+ lines by laser 4880 $\overset{o}{A}$, one can observe a series of emission lines with a diverse intensity and half – width. The analysis of the formes of the emission spectrum lines witnesses that in the range near to edge luminescence (2,11-2,21eV) one can observe recombinational processes of a least 2 kinds. Narrow lines (A_0^1- 2,1947eV and A_0^2 – 2,1925eV) which have an insignificant half – width (less than 0,2 meV) and the high intensification are conditioned by the radiation on bound exitons. The lines of emission with a half – width of about 2 meV are conditioned by the radiation on a free exitons with an emission of certain phonons. Narrow and intensive lines A_0^1 and A_0^2 are phonon less lines of the exiton bounded on the axially center of the symmetry.

The presence of the doublet of the phonon less lines A_0^1 and A_0^2 is explained by the structure of the exiton mentioned above, which consists of an electron with a spin $1/2$ and a hole with a spin $3/2$, bounded on the center with an axially symmetry, as well as by the predominance of the spin – orbit splitting determined by the crystalline field. In some crystals the intensification of the line A_0^1 overcomes that of A_0^2, what we can conclude that in this crystals the level π (I=1) has to be lower that the level $\sum$ (I=1). It agrees to the weak π polarization A_0^1 and to the weak δ polarization A_0^2. The lack of full polarization of these lines can be conditioned by the varied orientation centers. This also witnessed by the fact that is these crystals the phononless line is more intensive. Splitting A_0^1 and A_0^2 lines repeat itself in phonons replays.

The broad lines, combined with annihilation of the free exiton with an emission of phonons, are grouped in packages of $3 \div 4$ limes. Such a grouping is observed in spectra of single phonon combined dispersion, which is linked with optic phonons of the center of Brullouin zones with a varied symmetry.

In crystals with a complicated structure of the lattice and a great number of atoms in the elementary cell there is a great number of a oscillated modes and small impurity levels, on which exitons are linked. They determine the particularities of the luminescence and absorption processes. In this case the superposition of spectra takes place, which is conditioned by different mechanisms of the processes mentioned above.

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