

EXCITONS IN TlGaSe₂ CRYSTALS

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TaGaSe₂ semiconductors crystallize as a lamellar structure and have monoclinic lattice [1, 2]. One of the features of these crystals is a strong anisotropy of physical characteristics due to the specificity of the crystal structure [1 - 3]. The influence of temperature and pressure on the optical spectra near the absorption edge in TlGaSe₂ crystals were studied [4].

Two maxima at 2.168 eV and 2.189 eV due to the ground ($n^A = 1$) and excited ($n^A = 2$) states of long-wavelength excitons (marked as A excitons) is observed in λ -modulated transmission spectra. For A excitonic series the binding energy (R) of excitons is equal to 28 meV and band gap equals to 2.196 eV.

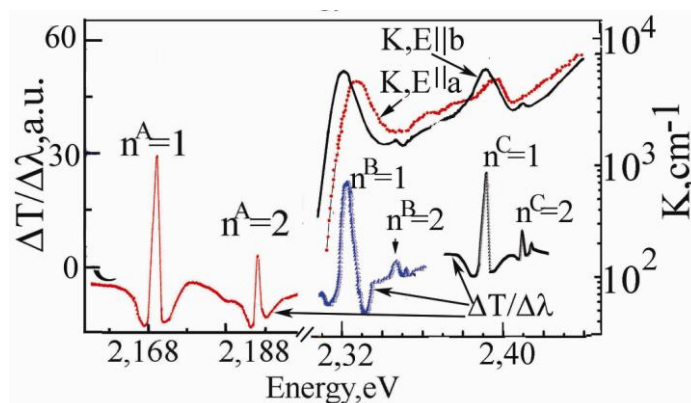


Fig. 1. Absorption (K) spectra in polarizations E||a and E||b and wavelength modulated transmission ($\Delta T/\Delta\lambda$) spectra of TlGaSe₂ crystals of thickness 7 μm .

The ground and excited states of B and C excitons were discovered in wavelength modulated transmission ($\Delta T/\Delta\lambda$) spectra at temperature 10 K. The observed absorption band at 2.3273 eV is due to $n^B = 1$ and line at 2.3450 eV to $n^B = 2$ states of B excitonic series. The binding energy (R) of this series excitons is equal to 23.6 meV and band gap equals to 2.3509 eV. Maxima of absorption and wavelength modulated transmission were observed at energies 2.390 eV and 2.4103 eV and can be attributed to the states $n^C = 1$ and $n^C = 2$ of excitonic series C, respectively. Authors of Ref. [4] reported about the observing in absorption spectra a maximum at 2.39 eV attributed to direct excitonic transitions. According our data the binding energy is corresponding to 28.4 meV and the continuum energy is equal to 2.4174 eV.

The indirect transitions in excitonic bands C₁ and C₂ with phonon emission and direct transitions of excitonic series A, B and C were observed in absorption spectra of TlGaSe₂ crystals. The ground and excited states of excitons were discovered in wavelength modulated transmission spectra for E||a and E||b polarizations. The main parameters of excitons and bands for all excitonic series as binding energy of excitons, reduced effective mass, masses of electrons and holes were determined.

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