Polarization - resolved luminescence of single CdTe/(Cd, Mg)Te quantum well in magnetic fields

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Luminescence from a single CdTe/(Cd, Mg)Te quantum well modulation-doped with iodine donors, excited with a 514 nm light from an Ar^+ laser, was observed at 1.8 K. Spectra in σ^+ and σ^- polarizations were registered at magnetic fields up to 9 T.

A preliminary analysis carried out previously [1] on data registered at temperature equal to 4.2 K led to the conclusion that the luminescence originates from recombination of free electrons and free holes. Results of a Fourier spectroscopy in the far-infrared [1] showed that electrons which constitute a two-dimensional electron gas in the sample studied can be described by an effective mass equal to $(0.1112 \pm 0.0003)m_0$ (m_0 is the mass of free electron) in the whole range of magnetic field applied. This allows us to assume that quantization of the density of states of the conduction band can be described by a standard model of Landau levels in a parabolic band, with energy described by $E_n = E_0 + \hbar\omega_c(n + 1/2)$, where n is the number of the level, E_0 is the energy of the bottom of the conduction band at $B = 0$ and ω_c is the cyclotron frequency.

A proper description of the Landau quantization of the valence band requires application of an advanced theoretical model based on the Luttinger Hamiltonian with taking into account calculations of energy levels of holes in a self-consistent potential of the quantum well. Such a description was previously [2] applied for an analysis of luminescence from a GaAs/(Ga, Al)As heterostructure and has been adopted now to the CdTe/(Cd, Mg)Te quantum well studied in this work.

We compared energy of observed transitions in luminescence with experimental data and found a generally good agreement. Some descripances which are found between the theory and experiment might be related to excitonic corrections to the transition energy. Also, a low temperature of the measurements could lead to localization of some holes which then would lead to free-to-bound transitions which are not described by the theory [2].

This research was partially supported by the Foundation for Polish Science through the IRA Programme co-financed by EU within SG OP and within EFSE and the Polish National Science Centre grant UMO-2019/33/B/ST7/02858.

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