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Magnetospectroscopy of a CdTe/ $Cd_{0.8}Mg_{0.2}Te$ quantum well

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We present results of magnetotransport and magnetospectroscopic studies on a single CdTe quantum well (QW) with $Cd_{0.8}Mg_{0.2}Te$ barriers modulation-doped with Iodine donors. Experiments were carried out at temperatures of about 1.8 K as a function of magnetic field up to 10 T and included measurements of: transport, THz transmission, photoluminescence, optically detected cyclotron resonance (ODCR) and reflectivity in the visible range.

Transport measurements determined concentration of a two-dimensional electron gas (2DEG) in the CdTe QW to be 3.3×10^{11} cm^{-2} in the darkness 3.4×10^{11} cm^{-2} after over the barrier illumination. These values were used to establish the filling factors in the analysis of optical spectra.
THz transmission measurements allowed us to determine the effective mass of electrons which was to be $(0.1020{\pm}0.0006)m_e$, consistent with earlier studies on CdTe QWs. Magnetoluminescence spectra showed the Fermi-edge-singularity shape that is characteristic for the case of QWs with such a high 2DEG concentration and allowed us to observe a band-to-band recombination between Landau levels in the conduction and valence bands. Combined with the determined mass of the free electron, this allowed us to determine the mass of the hole involved in the luminescence process. ODCR spectra showed that heating of 2DEG by absorption of a THz radiation leads to redistribution of electrons between all observable Landau levels, not just those adjacent to the Fermi energy. Reflectivity measurements revealed the presence of multiple resonances and provided valuable information about the energetical structure of levels of the QW under the influence of the internal electric field.

In conclcusion, we have shown on the example of CdTe/$Cd_{0.8}Mg_{0.2}Te$ QW that the combination of magneto-transport with THz and VIS magnetospectroscopy allows for a thorough characterization of the structure of quantum levels in a two-dimensional system. The comprehensive procedure applied in our study show the way to plan and carry out experiments on less known semiconductor objects.

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