Resonant tunneling in GaAs/AlGaAs double quantum wells

K. Surowiecka[1], H. König[2], A. Wysmołek[1], M. Potemski[2], M. Henini[3]

[1] *Institute of Experimental Physics, Warsaw University, Hoża 69, Warsaw, Poland*
[2] *Grenoble High Magnetic Fields Laboratory, CNRS&MPI, Grenoble, France*
[3] *School of Physics and Astronomy, University of Nottingham, England*
email: ksurow@fuw.edu.pl

Resonant tunneling in low dimensional structures attracted a lot of interest in the past. The biased double quantum wells offer many opportunities to study in detail the carrier transfer by use of optical techniques. The electric field lines up hole and/or electron levels localized in different wells under nonresonant conditions. Another advantage of using biased double quantum well structures is the possibility of creating conditions, which favor the appearance of neutral and charged excitons.

The investigated samples consist of two identical GaAs 60Å quantum wells embedded in $Al_{0.33}Ga_{0.67}As$ barrier and inserted in the insulated part of p-i-n junction. In order to separate effects related to the resonant tunneling from the other processes appearing under applied voltage, the structures with different separation between QWs were studied.

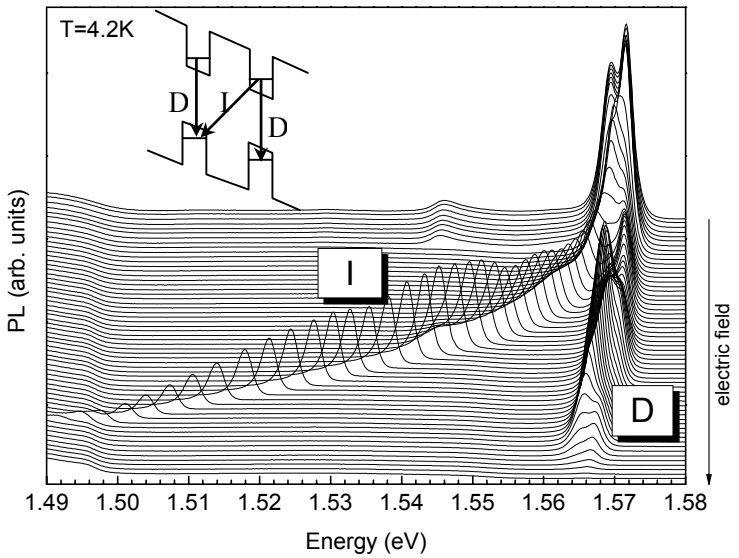

Fig. Low temperature PL spectra of the investigated structure under different electric fields. The schematic diagram of the investigated structure is shown in the inset.

The photoluminescence spectra of the sample with 50Å QW separation show both indirect (I) and direct (D) transition (see figure). For the sample with larger (150Å) separation only direct (intrawell) emission processes are observed.

Application of the external electric field changes relative energies of the electron and hole levels in the neighboring QWs what results in energy shift of indirect (interwell) transition observed for the structure with smaller QW separation (see figure).

It is very interesting that under applied voltage the intensities of direct and indirect transitions oscillate. The increase of the intensity in the range of direct transitions is associated with simultaneous intensity decrease observed for indirect transitions. The obtained results are discussed in terms of resonant tunneling of holes and/or electrons from one quantum well to the another.