Carrier density control by illumination in surface doped, p-type (Cd,Mn)Te quantum wells

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It has been established that suitable illumination can influence the carrier density in QWs. In several cases, reported so far, light was used to deplete the QW \cite{1,2}. An enhancement of carrier density was also observed in specially designed structures \cite{3,4}. Both cases can be exploited to broaden the experimental possibilities of studying the carrier induced effects.

In this work we observed both decrease and increase of the 2D carrier gas density in a simple (Cd,Mn)Te/(Cd,Mg)Te QW. The two effects were achieved for different photon energies of the illumination. Our samples contained 8nm or 10nm QWs with 2D hole gas supplied by surface states. For the sample with 25 nm cap layer thickness, it was possible to tune the hole gas concentration from almost empty well (hole density below \(1\times10^{10}\) cm\(^{-2}\)) to \(45\times10^{10}\) cm\(^{-2}\). The illumination with 425 nm wavelength almost doubled the hole gas density from the initial \(24\times10^{10}\) cm\(^{-2}\). The depletion mechanism was most effective for illumination with the orange (575nm) light. Figure 1 shows the carrier density variation as a function of the illumination photon energy.

![Illumination Wavelength vs Hole Gas Density Change](image1)

**Fig.1** Dependence of hole gas density change on the illumination photon energy. Continuous line denotes results for the single illumination experiment, dashed line presents results for the experiment with 590nm illumination bias. The inset presents photoluminescence spectra from the barriers under ion Ar Laser excitation - the photon energy scale is the same as for the main plot.

\[\text{References}\]


