High quality factor microcavities with CdSe/(CdMg)Se quantum wells

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Aim of this work is growth of high quality microcavities containing quantum wells (QW) for implementation in advanced photonic devices and for spectroscopy studies. During the growth of such complicated structures it is very important to use materials with a high difference of refractive index for Distributed Bragg Reflectors (DBRs). Moreover it is desired to maintain the same lattice constant of each layer to prevent formation of defects resulting with lattice mismatch. The next important requirement is a weak absorption in spectral range of cavity mode, which is spectrally resonant with the emitter. Consequently, energy gap of emitter (e.g. QW) should be as far as possible from absorption edge of materials used in growth of the DBRs.

In this work, we present new material system satisfying all the above requirements. Our DBR consists of ZnTe and short period superlattice MgSe|ZnTe|MgTe|ZnTe (lattice matched to ZnTe) [1]. Inside a cavity we grow CdSe QW embedded in (CdMg)Se barrier (with about 20% of Mg) [2]. Both CdSe and (Cd,Mg)Se are almost lattice matched to ZnTe, so they can be grown pseudomorphically, without relaxation.

For moderate Q-factor microcavites with 16 DBR pairs in lower mirror and 15 DBR pairs in upper mirror we observe 5 times enhancement of PL intensity, as compared to PL of QWs grown without any photonic structure. For structures with higher number of DBR pairs (22 in lower mirror and 20 in upper mirror), we obtained sharp mode in reflectivity spectrum with linewidth of 0.47 meV, which corresponds to the quality factor of above 3700 (Fig. 1). Under pulsed excitation, studied microcavities exhibit lasing with complex power dependence including two lasing thresholds.

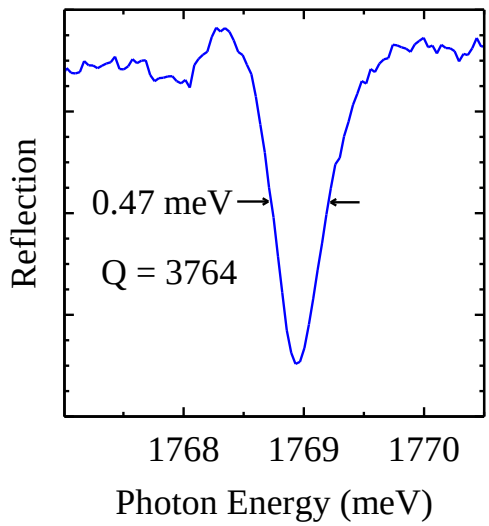

Fig. 1. Reflectivity spectrum containing microcavity mode with quality factor above 3700 measured at T = 7K. Quality factor is determined as 3764.

[1] W. Pacuski, C. Kruse, S. Figge, D. Hommel, *Appl. Phys. Lett.* **94**, 191108 (2009).

[2] R. Rudniewski, J.-G. Rousset, E. Janik, P. Kossacki, A. Golnik, M. Nawrocki, W. Pacuski, *Acta Physica Polonica A* **126**, 1167 (2014).