High quality factor and strong coupling in a fully lattice matched II-VI based microcavity containing magnetic quantum wells.

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Semiconductor microcavities are the basic element for the fundamental studies of cavity quantum electrodynamics and allowed for ground breaking the achievement such as the Bose Einstein condensation of cavity polaritons [1, 2] or investigations on the cavity polaritons superfluidity [3]. Concerning the applications for optoelectronics, it lead to the realization of low threshold polariton laser [4] and such devices as vertical cavity surface emitting lasers (VCSELs), or resonant cavity light emitting diodes (RCLEDs). Theoretical studies show the possibility to build fully polariton based logic circuits [5]. Since II-VI semiconductors exhibit stronger carrier confinement and more robust excitonic states than in III-V materials, II-VI based microcavities are expected to extend the functionalization of the devices and the fundamental investigations on light matter coupling to higher temperatures [6].

The challenge in the design and fabrication of high quality microcavities relies on the optimization linked to opposite constrains for the distributed Bragg reflectors (DBRs): lattice matching of the layers with different refractive index (to avoid the formation of defects and dislocations) and a high refractive index contrast (photon confinement efficiency within the cavity).

In this work, we present the design, growth by molecular beam epitaxy (MBE) and characterization of a monolithic microcavity lattice matched to MgTe and based on (Cd,Zn,Mg)Te layers with different Mg contents [7, 8] with respectively 23 and 20 Bragg pairs for the lower and upper DBR, embedding unstrained (CdZnMn)Te quantum wells (QWs). The DBRs and QWs have been specially designed to shift the absorption edge of the DBRs and the QWs emission into opposite spectral directions. The Mg content in the high refractive index (Cd,Zn,Mg)Te layer of the DBR (low energy gap) is higher than in the cavity. A thin CdMnTe layer grown in the center of the CdZnMnTe QW allows for a better exciton confinement and shifts the emission to longer wavelength. The resulting structure exhibits sharp emission lines from the QW, strong exciton-photon coupling, and compared to Ref[7] the quality factor of the cavity is about 30 times higher (Q>4000). Compared to the structure described in Ref[2], in our microcavity the absence of Mn, magnetically active, in the DBRs allows for magneto-optical studies of the cavity polaritons.

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