Determinaton of purcell effect in L7-type photonic crystal microcavities wth embedded InAs/InP quantum wires.

J. Canet-Ferrer[a], G. Muñoz-Matutano[a], L. J. Martínez[b], B. Alén[b], J.P. Martínez-Pastor[a], I. Prieto[b], P.A. Postigo[b], D. Fuster[b], Y. González[b], L. González[b]

[a]Instituto de Ciencias de los Materiales, Universitat de València, PO. Box 22085, 46071 Valencia, Spain.
[b]Instituto de Microelectrónica de Madrid (IMM-CNM- CSIC), Isaac Newton 8, E-28760, Tres Cantos Madrid, Spain
jose.canet-ferrer@uv.es

During the last decade it has been shown the spontaneous emission of an isolated quantum emitter can be coupled to single cavity mode [1]. More recently, the strong coupling between single quantum dots and two-dimensional photonic crystal micro-cavities has been demonstrated [2, 3]. In this work we have studied elongated L7-type cavities in 2D photonic crystals fabricated on InP substrates and containing InAs/InP QWRs grown by molecular beam epitaxy [4, 5], a promising system for telecommunication wavelengths. This system has been characterized by means of confocal micro-photoluminescence (micro-PL) and time resolved micro-photoluminescence (micro-TRPL) at 77K. The typical micro-PL spectrum of the quantum wires outside the cavities extends over 150 nm as shown in Fig. 1 (bottom), and typical decay times measured under low excitation regime varies between 2.1 and 2.6 ns (red squares on the top of Fig. 1). Recently it has been demonstrated room temperature continuous wave laser operation in the fundamental mode of L7 cavities [6]. For this reason, our samples are excited by means of a 980 nm wavelength laser dioe (resonant to the InP barrier) avoiding the contribution of the stimulated emission. This way the cavity resonances can be studied below the lasing threshold. As a result, a noticeable enhancement of the spontaneous emission is observed mainly for the first three modes. This fact is consistent with the quality factors reached by the cavity resonances (21600, 7040 and 1640 for modes emitting on 1480, 1460 and 1410 nm respectively) and its small modal volume ~ $(\lambda/n)^3$. On the other hand, the micro-PL decay time values measured at these modes (blue spheres on the top of figure 1) are smaller than decay times measured at the quantum wires outside the cavity, which suggests a certain Purcell effect even though under low coupling regime (a Purcell Factor close to 1.5). Such result are going to be discussed and compared with previous reports together with the possibility to reach the strong coupling regime using self-assembled QWRs as active media [7, 8].

References

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Figures

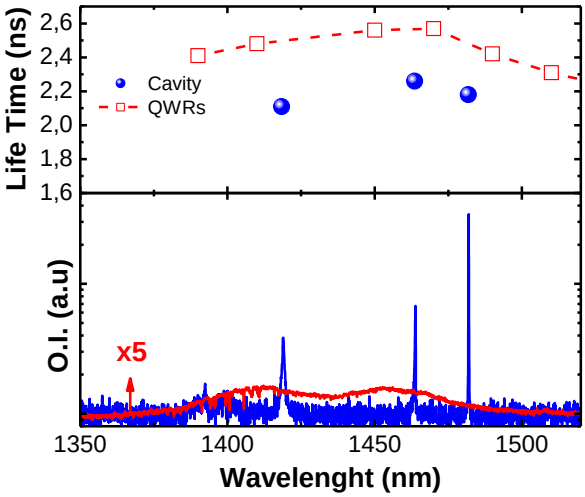

Figure1. (Top) Micro-TRPL spectrum of InAs/InP quantum wires (red squares and dashed line) accompanied of the measured decay times at the cavity resonances (blue spheres). On the bottom, the emission of the different modes (blue line) is compared with QWR emission band (in red).