Near thresholdless laser operation at room temperature

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Abstract

Laser emission using photonic crystal microcavities (PCM) [1] has opened new ways towards very low threshold and highly efficient solid state lasers with also very small size [2,3]. Recently, the term “thresholdless” has been used in the literature [4] to identify lasers presenting two main features: a spontaneous emission coupling factor (**β**) close to 1 and low non radiative losses. Non radiative losses are reduced by several orders of magnitude at cryogenic temperatures, although they can never be completely suppressed. When the spontaneous emission factor β is equal to 1 every photon emitted by the device is emitted in the lasing mode. Such "thresholdless" lasers were proposed by Noda [4] to be realized by combining QDs as light emitters and PCMs as high quality resonators. Using that recipe, ultra–low threshold lasing has been achieved at cryogenic temperatures using an ever–decreasing number of QDs within PCMs.[2,5-7] That strategy was adopted by Strauf et al. to demonstrate near thresholdless lasing at low temperature (4.5 K) by using few QDs (between 2 to 4) as active emitters and a high **β** =0.85 with power theshold values of 124 nW.[5] Khajavikhan et al. recently demonstrated thresholdless operation at low temperature (4 K) using metallic microcavities instead PCMs.[8] In this work we report a RT continuous wave (c.w.) laser with emission characteristics close to those of an deal thresholdless laser.[6]

References

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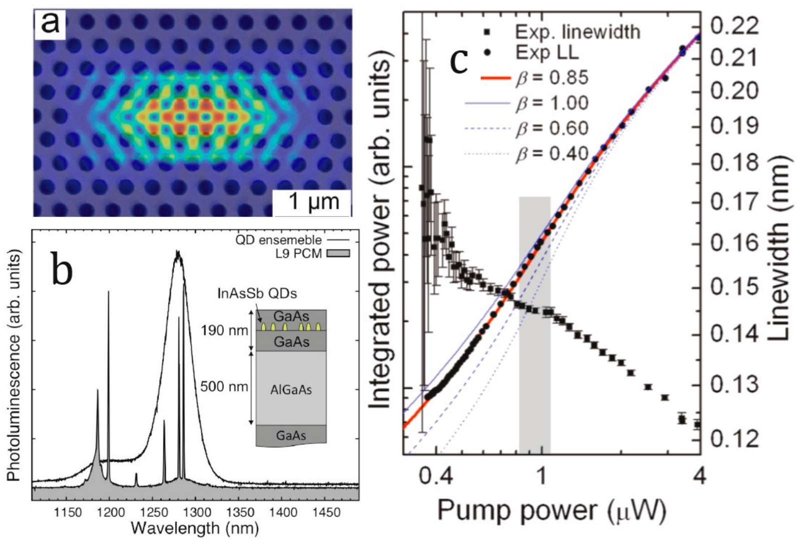

Figure (a) shows the calculated spectral distribution of the lasing mode superimposed to a SEM image of the photonic crystal microcavity (PCM). (b) shows the photoluminescence spectrum at RT of the ensemble of QDs outside (black line) and inside (grey) of the PCM; the inset describes the layers that compose the device. (c) shows the integrated power emitted by the laser versus the pump power and the theoretical fittings performed for different values of β.