Optical Properties of Coupled Photonic Molecules in Single Micropillar Geometry

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Coupled photonic molecules provide a stronger light confinement than the planar structures, which results in a stronger interaction between the light and matter. They offer also an ability of tuning the energy of the coupled modes by adjusting the molecule geometry and size. They are most often realized in side-coupled micropillar geometry, where the two micropillars etched in a close proximity out of the single microcavity are horizontally coupled.

Here we present the photonic molecule realized in a single micropillar geometry. The molecule is etched out of a sample containing two vertically coupled optical microvities. Thanks to a high symmetry and resulting low sidewall losses, the presented innovative design is promising for practical implementation in photonic devices requiring a high photon collection efficiency.

Micropillars are etched out of the coupled ZnTe planar microcavities (see Fig 1a).[1] Their diameter ranges from 3 μm down to 0.7 μm. The study of the molecules involves reflectivity and photoluminescence measured at T = 50 K. A microscope objective focusing the light to the spot of 1 μm diameter enables us to address and collect the signal from individual micropillars. The microstructuration results in a quantization of the cavity mode into a set of discrete submodes (see Fig.1b and inset to Fig.1c). The photoluminescence measurement performed with an angular resolution enables us to properly determine the origin and energy of a given submode. We evidence that with decreasing of the pillar diameter, both the submodes energy and energy spacing between the consecutive submodes increase (see Fig. 1c). This demonstrates that the sample microstructuration is an effective tool for tuning of the coupled modes energy, as well as for a control of the modes coupling strength.

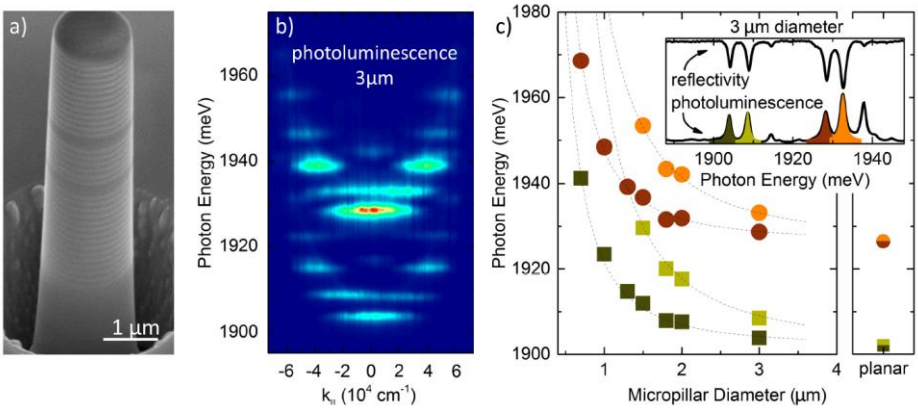

Figure 1: a) Scanning electron microscope image of an exemplary micropillar. b) Emission of a 3 μm micropillar as a function of the photon energy and the in-plane momentum. c) Energy dependence of the first two submodes of the coupled 3D photonic molecule.

[1] M. Sciesiek, W. Pacuski, J-G. Rousset, M. Parlińska-Wojtan, A. Golnik, J. Suffczyński, Design and control of mode interaction in coupled ZnTe optical microcavities, arXiv:1703.03226