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Quantum well exciton polaritons in a disk optomechanical microcavity

Our work focuses on hybrid optomechanical resonators embedding quantum wells (QW). A microscale mechanical Gallium Arsenide disk supports high Q optical whispering gallery modes (WGM) that strongly couple to the QW excitons, forming WGM polaritons. The resulting confinement in a sub-micron volume of mechanical, optical and excitonic modes, generates a tri-partite situation of interest for polaritonic optomechanics [1, 2].

We present optical experiments demonstrating the generation of polaritons in our disk structure. Optical modes and excitonic resonance are tuned by varying the temperature and the cavity dimensions. The strong coupling signatures, such as anti-crossing, are observed using both confocal microscopy at low temperature, and concomitant near-field experiments using a nanophotonic waveguide integrated on the chip and coupled to the disk. Rabi splitting values evolve between 6 and 10 meV, function of the concerned optical mode. The reported results agree with a Hopfield model including original analytical expressions of Rabi coupling for gallery mode resonators [2]. Finally, we present the first optomechanical experiments performed on the hybrid platform.

[1] Juan Restrepo, Cristiano Ciuti, and Ivan Favero. Single-polariton optomechanics. Physical review letters, 112(1):013601, 2014.

[2] N. Carlon Zambon Z. Denis C. Ciuti I. Favero R. De Oliveira, S. Ravets and J. Bloch. Enhanced cavity optomechanics with quantum-well exciton polaritons. Physical Review Letters, 129: 093603 , 2022.

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