PHD GRANT

Phonon mediated conversion of exciton-polaritons Rabi oscillations into THz radiation

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Semiconductor microcavities in the strong-coupling regime exhibit an energy scale in the terahertz (THz) frequency range fixed by the Rabi splitting between the upper and lower exciton-polariton states. While this range can be tuned by several orders of magnitude using different excitonic media, the transition between both polaritonic states is dipole forbidden. In this project, we show that, in cadmium telluride microcavities, the Rabi-oscillation-driven THz radiation is actually active without the need for any change in the microcavity design. We propose a frequency down-conversion scheme to generate THz radiation based on a chain of interactions naturally present in a pumped semiconductor microcavity: optical photons strongly couple to excitons that weakly couple to transverse optical (TO) phonons (Fig.1 a). The TO phonons strongly couple to THz photons. We derive the crucial exciton-phonon coupling, starting from the electron-phonon interaction via the deformation potential, taking into account the crystal symmetry. We identify conditions necessary for THz emission, estimate the emission power (Fig.1 b) and show that the exciton-phonon interaction provides a second-order susceptibility. This should allow the experimental realization of a new THz source working at room temperature.

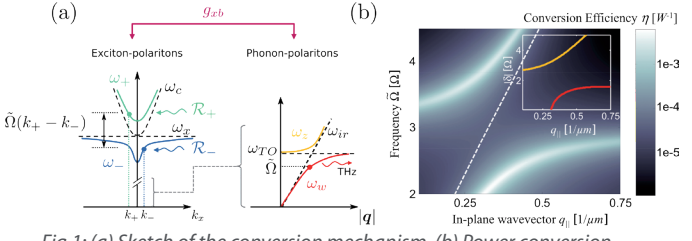

Fig.1: (a) Sketch of the conversion mechanism. (b) Power conversion efficiency of THz photons for resonant pumping

OUTCOMES

[1] Localization transition in the presence of cavity backaction, Phys. Rev. A 94, 013839 (2016)

[2] Enhanced Second-Order Nonlinearity for THz Generation by Resonant Interaction of Exciton-Polariton Rabi Oscillations with Optical Phonons, Phys. Rev. Lett. 119, 127401 (2017)

PhD cofunding: Saarland University, with a support from Université Franco-Allemande - Deutsch-Französische Hochschule

Oral presentations: Journée de la matière condensée, Août 2016, Bordeaux ; Deutsche Physikalische Gesellschaft (2016 and 2017) ; 66th Lindau Nobel Laureate meeting (2016)
ANR «Quantum fluids of light» 2016-2020

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