

Room temperature polariton lasing and condensation effects in III-nitride microcavities

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The recent demonstration of room temperature (RT) polariton lasing in a bulk GaN microcavity (MC) has established the possibility to use nitride semiconductors for the realization of polariton-based devices [1]. Indeed, those structures could be used as novel low threshold coherent light emitting sources or micro optical parametric amplifiers. Unfortunately, achieving an efficient electrical injection within a bulk GaN active region is difficult. As a result the realization of an electrically pumped polariton laser based on such bulk samples should reveal highly challenging. A way to push forward polariton-based devices consists in achieving a well-grounded RT strong coupling regime (SCR) and demonstrating nonlinear effects in quantum well (QW) MCs for which the realization of an electrically pumped device should be more realistic. This would add to the recent demonstration of GaAs-based polariton light-emitting diodes operating at cryogenic temperatures [2]. In this context, we have recently proposed an approach different from that commonly employed in III-arsenides, namely the use of a GaN/AlGaIn multiple QW active region [3]. This structure has allowed the demonstration of the SCR at RT with a record vacuum Rabi splitting value for a semiconductor QW MC ($\sim 50\text{meV}$) [3].

Here, we will report on the emission properties of this type of MCs under nonresonant optical pumping. It will be shown that the samples exhibit a nonlinear emission threshold at RT while remaining in the SCR (Figs. 1(a)-(b)) [4]. Experimental results will thus be depicted within the picture of polariton lasing and prospects regarding the realization of an electrically pumped polariton laser will be given. Furthermore, we will also address how these results can be linked to RT Bose-Einstein condensation of polaritons [5-6]. In this context, the thermalization process of the photogenerated quasiparticles will be described. The behavior of the nonlinear emission threshold versus polariton trap depth and temperature as well as that of the polarization of the emitted light below and above threshold will also be discussed.

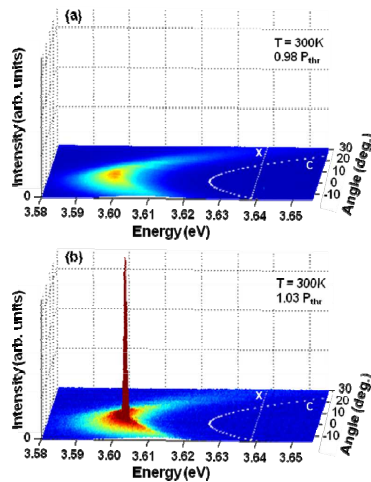


Fig. 1: (a) 3D representation of the far-field emission with emission intensity displayed on the vertical axis (linear vertical scale) below and (b) above threshold. The position of the cavity mode (C) and the uncoupled exciton (X) is also reported.

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