Polariton dispersion relations under condensation in a CuBr microcavity

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Exciton polaritons in semiconductor microcavities, the so-called cavity polaritons, are bosonic quasiparticles resulting from the strong coupling between excitons and cavity photons. In this work, we have investigated the characteristics of polariton condensation from the viewpoint of dramatic changes of the polariton dispersion relation in a CuBr microcavity with the use of angle-resolved photoluminescence (PL) spectroscopy.

The sample used was a λ-thick CuBr microcavity with HfO_2/SiO_2 distributed Bragg reflectors prepared on a (0001) Al_2O_3 substrate. The CuBr microcavity has a giant Rabi splitting energy of ~110 meV, which indicates high stability of the cavity polariton. The excitation light source was the third harmonic generation light (355 nm) of a pulsed YAG laser with a pulse duration of 2 ns. Figures 1(a) and 1(b) show the image maps of PL spectra at 0.1 and 19 W/cm^2, respectively, at 77 K as a function of in-plane wave vector $k_{//}$. In Fig. 1(a), the PL energies just agree with the dispersion of the lower polariton branch (LPB) indicated by the solid curve. In contrast, in Fig. 1(b), the PL energy is considerably blueshifted from the LPB dispersion, and the PL-intensity distribution exhibits a flat profile. This phenomenon is consistent with a diffusive Goldstone mode peculiar to non-equilibrium Bose-Einstein condensation [1]. The renormalized LPB dispersion in the polariton condensation is reasonably analyzed on the basis of the theory for the diffusive Goldstone mode [1] as shown by the dotted line in Fig. 1(b).

[1] M. Wouters and I. Carusotto, Phys. Rev. Lett. **99**, 140402 (2007).

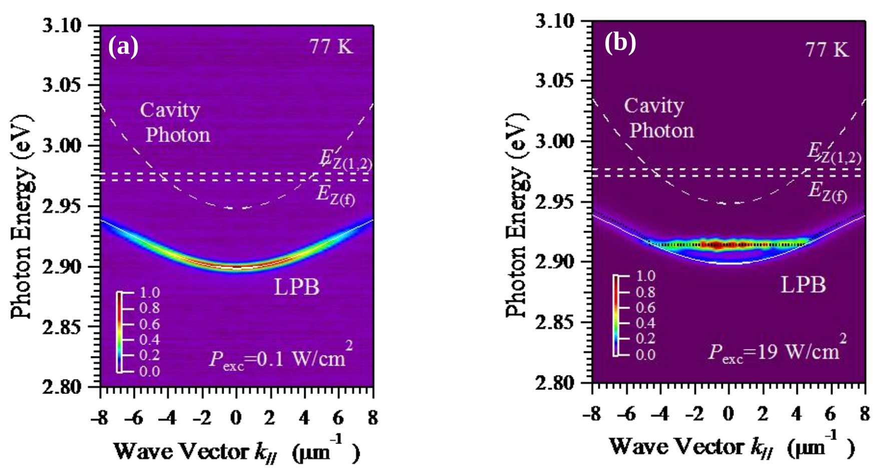

Figure 1: Image maps of PL spectra at (a) 0.1 and (b) 19 W/cm^2 at 77 K as a function of in-plane wave vector $k_{//}$, where the solid curve indicates the LPB dispersion obtained from analyzing the incident-angle dependence of reflection-signal energies of the cavity polariton.