http://www.phy.pku.edu.cn/~icmp/forum/njt.xml

Evaporative cooling induced exciton-polariton condensatein a ZnO microcavity

Abstract Exciton-polaritons exhibit a number of intriguing properties reflecting their half-light, half-matter nature. Unlike the BEC phase transition of cold atom gas, the polariton system can be hardly found in a full thermal equilibrium due to the limited lifetime of polaritons. For achieving the condensation threshold in a bosonic gas, an efficient cooling mechanism is essential. In an exciton polariton gas, because of the solid state environment, light effective mass and the exciton component, the cooling and/or energy relaxation of polaritons and thus the realization of polariton BEC is mediated by the phonon relaxation which may be stimulated by the final state occupation. We remind that, in order to cool down a gas system, its mean kinetic energy should be reduced by evaporating the high energy particles. This process is referred to as evaporative cooling. It can build up the phase-density within a short time interval, which is why it has been widely used to achieve the BEC in cold atom systems. When polariton gas is trapped in a three-dimensionally confined potential well with a limited barrier height, the evaporative cooling can be strongly enhanced by the polariton-polariton scattering due to the tight confinement from the trap. Basing on a quasi-zero-dimensional microcavity of ZnO, we demonstrate the efficiency of this cooling mechanism in a polariton gas system with well defined discrete energy spectrum which relaxes closely to the thermal distribution, and show that it allows reducing the effective temperature of the polariton gas down to about 20 K in the room temperature experiments.

: yudp@pku.edu.cn

Photograph by Xiaodong Hu