Bose-condensation of dipolar excitons in lateral traps in heterostructures

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Spatially indirect, dipolar excitons photoexcited in coupled and single quantum wells under electrical bias applied normal to heterolayers constitute a rather promising object for realization of excitonic Bose-Einstein condensation (BEC). When critical conditions for both temperature T and concentration N (or pumping intensity P) are achieved, BEC occurs spontaneously in a reservoir of rather long-lived and cold gas of interacting dipolar excitons collected in a lateral trap. BEC is manifested by the abrupt appearance in the luminescence spectrum of a narrow line of dipolar excitons collected in a trap and condensed in the vicinity of $\boldsymbol{k} \cong 0$. This phenomenon is accompanied simultaneously by the formation of spatially-symmetric luminescent spot pattern within a perimeter of a trap. Spatial pattern structure and its visibility is strongly temperature dependent in accordance with found phase diagram. The observed effect of the linear polarization of luminescence by the Bose–Einstein condensate of dipolar excitons accumulated in the ring lateral traps is a manifestation of spontaneous symmetry breaking under Bose–Einstein condensation.

Dipolar exciton condensate accumulated in a ring trap exhibits large-scale off-diagonal spatial coherence confirmed by measuring of the 1st order correlator $g^{(1)}(r, r')$ by means of two-beam interference experiments with the use of cw and pulsed photoexcitation. Statistics of photons emitted by exciton Bose-condensate (the 2d order correlator, $g^{(2)}(\tau)$) have been studied at condensation threshold in the temperature range of (0.45÷4.2) K. Photon "bunching" has been observed at the Bose condensation threshold. At the excitation pumping well above the threshold, when the narrow line of exciton condensate begins to grow in the luminescence spectrum, the photon bunching is decreasing and finally vanishes with further excitation power increase. In this pumping range, the photon correlation distribution becomes Poissonian reflecting the single quantum state nature of excitonic Bose condensate. The effect of a magnetic field on a spinor dipolar exciton bose-condensate has been presented and discussed in comparison with the same observed phenomenon for spinor exciton-polariton condensate in microcavitiy.