Low temperature behavior of excitons in an optically-induced trap

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We report on the behavior of a low-temperature gas of indirect excitons in an optically-induced exciton trap. We have recently proposed and demonstrated optically-induced trapping of indirect excitons in coupled quantum wells (CQW) [1]. An important advantage of the optically-induced exciton trapping is the possibility of controlling the trap in-situ by varying the laser intensity in space and time [2]. We exploit this opportunity and report studies of exciton kinetics in the optically-induced trap. Studies have demonstrated formation of the trap and collection of ~10^5 cold excitons to the trap over the course of 40 ns after the excitation is switched on [2], which meets the essential condition that trap loading time be smaller than the lifetime of the indirect excitons. For comparison, typical atomic optical traps have loading times for degenerate atomic gases that are on the order of a few tens of seconds, while the lifetimes of atoms in the trap are on the order of a few seconds [3, 4].

Experiments with indirect excitons have demonstrated that (i) the excitons travel to the trap center before recombination and the trap loading time is smaller than their lifetime and (ii) the excitons at the trap center are cold (because they are far from the hot area of the laser excitation). This leads to the accumulation of a cold and dense exciton gas at the trap center. The theoretical analysis of the dynamics of the degenerate Bose gas of excitons in the trap is in good agreement with the experimental data. Ongoing experiments are currently in progress to investigate optically-induced trapping of excitons at ultra-low temperatures.

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