Towards a stable Bose-Einstein condensate of excitons in a bulk semiconductor

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Realization of macroscopic quantum coherence such as Bose-Einstein condensation (BEC) in an ensemble of excitons in a semiconductor, has been a central issue in solid-state spectroscopy for more than forty years. Condensation of long-lived excitons in a bulk semiconductor that are decoupled from photons is of particular interest, since such excitons behave as purely matter-like quasiparticles and the condensate would show novel characteristics. Here we explain why it has been difficult to meet the BEC criteria above 2 K, and we present a series of experimental results where (1) we observed the transition to an exciton BEC in a three-dimensional trap at sub-Kelvin temperatures[1], and (2) realized a record-breaking low exciton temperature to stabilize the condensate by using a dilution refrigerator.

1. K. Yoshioka, E. Chae, and M. Kuwata-Gonokami, Nature Commun. 2, 328 (2011).

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