CONTROLLED DRIFT OF LONG-LIVING EXCITONS IN TUNABLE POTENTIAL LANDSCAPES

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In this contribution we report on experimental progress of controlling the spatial and temporal dynamics of long-living excitons. We observe excitonic drift phenomena in static and in time-dependent voltage-tunable potential landscapes for excitons [1]. A profound understanding of manipulating exciton dynamics is crucial for designing efficient traps for excitonic Bose-Einstein-Condensates [2].

We create long-living, spatially indirect excitons in epitaxially grown coupled GaAs-quantum well (QW) structures at low temperatures (~ 4K). Exploiting the quantum confined Stark effect, in such structures the recombination lifetime of photo-generated excitons is as long as several µs [3]. In the plane of the coupled QWs we induce controlled and tunable potential landscapes for excitons by arrangements of semi-transparent metallic gates [4]. Lithographical techniques offer vast options in designing gate layouts.

We induce a gradient potential for excitons via current-carrying resistive gates. Temporally and spatially resolved photoluminescence measurements reveal an excitonic drift velocity larger than 10^3 m/s over distances exceeding 150 µm. We also demonstrate that excitons can be guided via a time-varying potential. Using an interdigitated gate structure we create a voltage-controlled undulated potential landscape. Time-resolved photoluminescence measurements unveil that excitons follow the change in the potential landscape which is initiated by electrically pulsing the gates.

The experimental results presented yield direct insights in exciton dynamics in controlled potential landscapes. This enables us to design and to test artificial traps for excitons needed to accumulate large exciton densities, a prerequisite for excitonic Bose-Einstein-Condensation.

References:

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