Halbleiter-Nanophotonik

SFB 787

Einladung

Es spricht: **Dr. Jacek Kasprzak**
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Zeit: **Montag, 06. Juni 2016, 15:00 Uhr**

Ort: **Technische Universität Berlin**
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Thema: **„Coherence of individual emitters in photonic nanostructures"**

Abstract:

I will highlight recent advances in retrieving and manipulating coherent nonlinear responses of semiconductor nanostructures. In particular, wave mixing spectroscopy is a well-established approach to infer coherence and population dynamics of exciton ensembles, for instance confined in quantum wells. I will start by revisiting this physics by demonstrating enhanced four-wave mixing (FWM) response in monolayers of transition metal dichalcogenides [1], in particular in $MoSe_2$. I will discuss the impact of a local disorder and temperature on exciton dephasing and lifetime in this material. Performing FWM spectroscopy on individual transitions, like excitons in single quantum dots (QDs), is far more challenging due to an overwhelming ratio (typically $10^{6..8}$ in the field) between the required resonant optical driving and the amount of the emitted FWM signal. In this talk, I will show that by embedding a QD in well designed photonic devices - like planar GaAs [2,3] or CdTe [4] microcavities, one-dimensional waveguides antennas [5] or deterministic microlenses [6] - one can suppress the background-signal ratiodown to $10^{2..4}$, abolishing a long-standing issue regarding a poor retrieval efficiency of coherent responses from single excitons. Such dramatically increased sensitivity of the measurements opens novel opportunities in this field. It enables to verify theoretical proposals, which until now have been considered as experimentally unfeasible. I will highlight two such examples. The first one, is to monitor polaron formation and to reveal corresponding phonon-induced dephasing in a QD[6]. The second one, involves implementation of novel, fast, coherent control schemes via multi-wave mixing [2]. As an outlook, I will focus on ongoing experiments, using stochastic and deterministic approaches, aiming to demonstrate long-range radiative coupling within a pair of distant excitons.

[1] T. Jakubczyk, V. Delmonte *et al. Radiatively limited dephasing and exciton dynamics in MoSe*2 *monolayers* resubmitted in Nano Letters (2016).

[2] F. Fras, Q. Mermillod *et al.*, *Multi-wave coherent control of a solid state single emitter*,Nature Photonics 10, 155 (2016).

[3] Q. Mermillod, D. Wigger *et al. Dynamics of excitons in individual InAs quantum dots revealed in four-wave mixing spectroscopy* Optica 3, 377 (2016)
[4] ongoing research
[5] Q. Mermillod, T. Jakubczyk *et al.*, *Harvesting, coupling, and control of single-exciton coherences in photonic waveguide antennas*, Physical Review Letters 116, 163903 (2016).
[6] in preparation (2016), *Impact of phonons on dephasing of individual excitons in deterministic quantum dot microlenses*

Gäste sind herzlich willkommen!
Prof. Dr. S. Reitzenstein