NEXTInvitedScientists

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Dates of stay	From	26.02	to	17.03	2017

BriefBiodata

I have finished my PhD at the University of Warsaw in the Faculty of Physics in 2003. The subject of my thesis, conducted under the supervision of prof. Michal Nawrocki, was tunneling dynamics of excitons in a system of coupled quantum wells. Subsequently, I have joined as a post-doc the group of prof. Luis Viña at the Autonomous University in Madrid, where I investigated light emission dynamics from semiconductor microcavities. After returning to Poland, I was employed at the Institute of Physics, Polish Academy of Sciences. I am involved in optical investigations of different semiconductor nanostructures, most notably self assembled quantum dots and, recently, monolayer transition metal dichalcogenides.

Research project during the visit at NEXT

Descriptive Title Exciton dynamics in van der Waals heterostructures

Transition metal dichalcogenides (TMDs) are a family of materials, in which subsequent layers are bound together with van der Waals forces. Monolayer TMDs have recently emerged as a new class of two dimensional semiconductors, where new physical effects can be studied and new device application may be envisioned. Monolayer thickness leads to strongly bound electron-hole pairs, excitons, and excitonic effects determine optical properties up to room temperature. Another property that distinguishes monolayer TMDs from 'conventional' semiconductors such as Si or GaAs, is a possibility to optically address specific band minima – valleys. The valley constitutes a binary index and thus, in analogy to spin, has been proposed as a carrier of information. However, before any device is realized, detailed understanding of the dynamical properties of electrons, holes, and excitons in TMDs is necessary. In this project, we investigated optical properties of a TMD heterostructure – a stack of three TMD monolayers: MoS_2/MoS_2/MoS_2. Fabrication of such a stack results in a band alignment facilitating separation of electrons and holes and, consequently, leads to appearance of a spatially *indirect* exciton. Contrary to *direct* excitons whose lifetimes are usually too short to measure with photoluminescence techniques, such entities exhibits a very long lifetime enabling detailed studies of its dynamics. Within this NEXT project we investigated both the steady-state and dynamical properties of the indirect excitons. In particular, we discovered a peculiar carrier relaxation path that leads to inversion of the observed light polarization reflecting ultrafast electron intervalley scattering.