Colloquium Announcement
of the Collaborative Research Centre 951
“Hybrid Inorganic/Organic Systems for Opto-Electronics”

Andrey Turchanin
Institute of Physical Chemistry, Friedrich-Schiller-Universität Jena, Germany

2D inorganic and organic materials and their hybrids for implementation in electronic and photonic devices

Andreas Knorr
Institute for Theoretical Physics, Technische Universität Berlin, Germany

A theoretical approach to interfacial charge and energy transfer: atomically thin semiconductors functionalized with graphene, metal nanoparticles and dye molecules

Time: Thursday, 22.04.2021, 15:15
Place: The colloquium takes place online (ZOOM)
Meeting-ID: 645 8806 9997
Password: 951951
Two-dimensional (2D) inorganic and organic materials and their vertical and lateral heterostructures exhibit a manifold of novel physical phenomena as well as open broad avenues for their implementation in electronic and photonic devices. In this talk I will give an overview of our recent progress on the synthesis, characterization and applications of these materials with a particular emphasis on their structure-property relationships and engineering on novel 2D material-based inorganic-inorganic and inorganic-organic hybrids. The examples will include demonstration of the scalable high-quality chemical vapor deposition (CVD) synthesis of monolayers (MLs) of transition metal dichalcogenides (TMDs) [1-3], rise of the giant persistent photoconductivity in TMD MLs due to variation of the intrinsic defect density [4], study of the interlayer excitons in the stacked van der Waals (vdW) bilayers of the CVD grown MoS$_2$ [5], CVD growth of monolayer MoSe$_2$-WSe$_2$ lateral heterostructures and their implementation in various electronic and optoelectronic devices [6], assembly and characterization of van der Waals heterostructures of organic and inorganic 2D materials for photonic and electronic applications [7-8].

A theoretical approach to interfacial charge and energy transfer: atomically thin semiconductors functionalized with graphene, metal nanoparticles and dye molecules

D. Christiansen, M. Katzer, R. Salzwedel, L. Greten, M. Selig, A. Knorr

Institute for Theoretical Physics, Technische Universität Berlin, Germany

Atomically thin semiconductors constitute a remarkable playground for exciton physics in two dimensions. This involves optically accessible (bright) as well as spin- and momentum-forbidden (dark) excitonic states including intravalley and intervalley excitations. Here, we present applications of a many-body theory to charge-, Dexter- or Förster-type transfer processes at interfaces of atomically thin semiconductors functionalized with graphene, metal nanoparticles and dye molecules.

In particular, as a new process, we also introduce exciton-plasmon conversion from WSe_2-excitons to graphene-plasmons. Our results are compared to experimental results in the CRC, AG Ernstorfer and AG Bolotin.