Fritz-Haber-Institut der Max-Planck-Gesellschaft

Physikalische Chemie — Direktor: Prof. Dr. Martin Wolf

MAX-PLANCK-GESELLSCHAFT

Department Seminar:

Monday, November 4, 2019, at **11:00** a.m.;
— all are invited to meet at around 10:40 for a chat with coffee & cookies —

Dr. Hai Wang

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Charge Carrier Dynamics in Carbon-based Optoelectronic Materials and Interfaces

PC Seminar Room G2.06, Building G, Faradayweg 4 Y. Tong

Abstract:

In photovoltaic and photochemical cells, charge carriers are generated and transported in photo-active materials and collected at the materials/electrode or electrolyte interfaces. Understanding and eventually controlling the generation, transport, and collection of charge carriers are therefore crucial for improving the energy conversion efficiency of devices. In this presentation, I will present our ongoing work on investigation of the charge carrier dynamics in optoelectronic nanomaterials and interfaces using terahertz (THz) spectroscopy, with a special focus on carbon-based nanostructures including graphene and graphene nanoribbons. *The first part of the talk* will focus on the fundamentals of interfacial charge carrier (including both ionic and electronic) dynamics at graphene-based solid-electrolyte and solid-solid interfaces. Graphene has been widely used for electrochemical energy storage (e.g. in Li-batteries, ionic sensors) and photodetectors, thanks to its chemical stability, exceptionally high electronic conductivities and superior optical properties. In all these applications, although transfer of ions and electrons across various graphene-liquid (often - electrolyte) and graphene-solid interfaces is known to play a critical role on the device efficiency, the underlying mechanism governing the processes remain largely unexplored. I will present two of our recent studies related to (1) tracking the kinetics of cation permeation through graphene membranes, and (2) monitoring hot electron transfer processes at graphene-2D semiconducting interfaces. The second part of the talk will deal with graphene nanoribbons. Due to its semimetal characteristics of graphene's band structure, the on-off ratio in the graphene-based transistor is too low to be useful for practical applications. It has been a long standing pursuit, to open up and control the bandgap in graphene, by tailoring the graphene into its nanoribbons with atomic precision. Recent advances in bottom-up synthesis in Mainz (in the group of Dr. Akimitsu Narita and Prof. Klaus Mullen) now allow atomic control of graphene nanoribbons (GNRs) with well-defined bandgap and optical properties. I will discuss some of our recent ultrafast THz conductivity studies on GNRs, which demonstrates the strong exciton effect in GNRs owing to the reduced charge screening effect.