Fritz-Haber-Institut der Max-Planck-Gesellschaft

Physikalische Chemie — Direktor: Prof. Dr. Martin Wolf

MAX-PLANCK-GESELLSCHAFT

Department Seminar:

Monday, September 23, 2019, at **2:00** p.m.;
— all are invited to meet at around 1:40 for a chat with coffee & cookies —

Adj. Prof. Kunie Ishioka Research Center for Advanced Measurement and Characterization
National Institute for Materials Science, Tsukuba, JP.

Ultrafast Phonon and Carrier Dynamics at Semiconductor Hetero-interfaces Studied by Transient Reflection and Transmission Measurements

PC Seminar Room G2.06, Building G, Faradayweg 4 M. Wolf

Abstract:

Hetero-interfaces between two different materials often show different electronic and phononic properties from bulk, which gives a basis to modern opto-electronic device technologies. In the present talk I present our recent results on two different hetero-interface systems.

Thin GaP films can be grown on Si(001) with nearly perfect lattice match. We perform pump-probe reflectivity measurements on the buried GaP/Si(001) interface either above or below-bandgap excitation. The above-gap photoexcitation can induce coherent LO phonons in the GaP film, whose coupling with photoexcited plasma is found to depend on the GaP thickness due to the quasi-two-dimensional confinement of the plasma [1]. The same laser pulse can also generate coherent LA phonons at the GaP/Si interface as well as at the GaP surface [2], suggesting a possibility for an application as an opto-acoustic transducer.

Lead halide perovskite solar cells, which have been developing rapidly in the past few years, typically consist of a perovskite film sandwiched between thin layers of electron- and hole-transport layers. We monitor the charge separation dynamics at the interfaces of $CH_3NH_3PbI_3$ with three typical hole transport materials (HTMs) using differential transient transmission measurements [3]. The differential signals reveals the hole injection from the perovskite to organic HTMs, PTAA and PEDOT:PSS, to occur on the time scale of 1 ps, whereas that to inorganic NiO_x an order of magnitude longer. We find an anti-correlation between the hole injection time and the fill factor, one of the key device properties, of the solar cells made with the three different HTM

References:
[1] Ishioka *et al.*, *J. Phys.: Cond. Matter* **31**, 094003 (2019).
[2] Ishioka *et al*., *Appl. Phys. Lett*. **111**, 062105 (2017).
[3] Ishioka *et al.*, *J. Phys. Chem. Lett.* **8**, 3902 (2017).