Visiting Professors

Visiting Professor
FUKUI, Ken-ichi *(from Osaka University)*

Ionic Liquid/Organic Semiconductor Film Interfaces for Efficient Carrier Transport

Local analyses of electrolyte/organic semiconductor electrode interfaces at controlled electrode potentials are of fundamental importance to understanding the origin and properties of the electric double layer (EDL) at the interfaces, which is necessary for their application to EDL-organic field effect transistors (OFETs). Ionic liquids (ILs) gated EDL-OFETs can be operated with ultralow threshold voltage (~0.1 V), and high electric field of the EDL restrict the hole carrier at the organic molecular facing the interface, thus a few molecular layer film works as the efficient device. By adopting newly developed electrochemical ATR-FUV (EC-ATR-FUV) system for the analyses of electronic states of the device consisting of a two-layer-thick C9-DNBDT-NW film and an IL (EMIM-FSA), we have succeeded to obtaining the hole carrier density as low as 1/500 hole per a C9-DNBDT-NW molecule. The spectrum analyses also provided the information of interaction between the organic thin film and the IL. Further analyses of the system using UVSOR are in progress.

Visiting Professor
SHIMADA, Kenya *(from Hiroshima University)*

High-Resolution Angle-Resolved Photoemission Study of Topological Materials

By means of high-resolution angle-resolved photoemission spectroscopy (ARPES), we clarify electronic structures of solids (band structures, Fermi surface, spin polarization) to understand their physical properties from the microscopic point of view. This year, we have examined the antiferromagnetic topological insulator families $(Bi_2Te_3)_nMnBi_2Te_4$ (n = 1,2). We have observed the electronic band structures specific to the surface termination, which are fully consistent with detailed density functional theory (DFT) calculations. It indicates the surface termination is important for the surface states on $(Bi_2Te_3)_nMnBi_2Te_4$. We have also examined the spin texture of a photocatalyst BiOI. There are two Bi-I sectors connected via the centrosymmetric point, and we found that the topmost iodine layer had a helical spin texture with a spin polarization up to ~80%. Based on the detailed theoretical considerations, the high spin polarization on each sector is protected by the non-symmorphic lattice symmetry (P4/nmm) together with the strong spin–orbit interaction. We have confirmed that the spin-momentum-layer locking effect in BiOI. To improve the spatial resolution of high-resolution ARPES on the HiSOR beamline, we have introduced a highly precise XYZ translator with the absolute accuracy of <1μm and developed the spatial mapping mode.

Visiting Associate Professor
KATSUKI, Hiroyuki *(from Nara Institute of Science and Technology)*

Coherent Control in Condensed Systems

Coherent control is a technique to manipulate quantum states of a target system utilizing the interference of wavefunctions. Highly designed ultrashort laser pulses, both temporally- and spatially-modulated, are used to manipulate the amplitudes and phases of the target wavefunctions. Current my research is focused on the coherent control in various condensed phase systems including strongly coupled systems composed of cavity photons and molecular excited states. Especially, vibrational polaritons which are composed of the molecular vibrational states and mid-infrared cavity photons are of great interest due to the possibility to manipulate the dynamics of chemical reactions. This is possible since the ground state potential surface is locally modulated by the formation of polaritons. Now we are preparing a femtosecond pump–probe and other nonlinear spectroscopic setups to track the ultrafast dynamics of such strongly coupled vibrational polariton systems.