Visiting Professors

Visiting Professor
KANAI, Kaname *(from Tokyo University of Science)*

Electronic Structure of Organic Molecules/Metal Interface

Fundamental questions about the adsorption of organic molecules on metal have gained importance also in applied research because the electronic structure at the interface between organic semiconductors and electrode metals (organic/metal interface) has a direct effect on the electric properties of various organic semiconductor devices. We have investigated how the electronic structure at the organic/metal interface is formed upon the adsorption of organic molecules by monitoring the modification of metal surface state (SS) induced by the adsorption of organic molecules using angle-resolved photoemission spectroscopy. Recently, we have focused on the interface between a well-ordered *n*-alkane monolayer and an Au(111) as an example of physisorption of organic molecule. We observed the shrinkage of quasi-free electron-like Fermi surface and enhancement of Rashba splitting of the SS upon the adsorption of the molecules. This substantial change in the metal SS directly shows that there is a certain amount of orbital interaction even in this ideal physisorption system. We have just started to investigate the other molecular systems.

Visiting Associate Professor
HIRAHARA, Toru *(from Tokyo Institute of Technology)*

Spin-Split States at the Surface/Interface of Nonmagnetic Ultrathin Films/Topological Materials

Recently there has been growing interest in utilizing the spin degree of freedom in electronic devices, the so-called *spintronics*. The conventional way is to use magnetic materials and manipulate the spin using a magnetic field. However, it is sometimes troublesome to apply a magnetic field to nano-scale materials and it is much easier to control the spin properties of materials using an electric field. By making use of the Rashba effect in which electrons become spin polarized in k-space due to spin–orbit coupling effects at the surface, such manipulation of electron spin with an electric field becomes possible, *i.e.*, a spin field effect transistor can be realized in such materials. We are developing a high-resolution spin- and angle- resolved photoemission spectroscopy measurement system equipped with *in situ* surface sample preparation facilities at BL-5U and characterize the novel spin property at the Rashba-split surface/interface states of nonmagnetic ultrathin films. We will also try to grow thin films of novel topological materials such as Dirac/Weyl/line-nodal semimetals. Furthermore, we will try to study the interplay between magnetism and the Rashba effect.

Visiting Associate Professor
KISHIMOTO, Tetsuo *(from University of Electro-Communications)*

Development towards Continuous Production of Bose-Einstein Condensates

Our goal is to realize continuous production of Bose-Einstein Condensates (BEC) based on all-optical techniques. By using sympathetic cooling techniques, this can further extend the possibility of realizing CW BECs for many other different atomic species or even molecules that are not eligible for direct evaporative cooling. So far we have explored the possibility of using the narrow $5S_{1/2}$–$6P_{3/2}$ cooling transition, however continuous loading of atoms into an optical dipole trap with this transition has not been successful so far. We have tuned this dipole trap to a special wavelength but the hyperfine states in the excited state experiences some vector light-shift, which may be the cause of insufficient cooling during the continuous loading. To avoid such vector shifts, currently we are moving toward the next approach of using a so called gray-molasses (GM) cooling with the $5S_{1/2}$–$6P_{1/2}$ transition. There has been no report of GM-cooling so far using such transitions with different principle quantum numbers.