Visiting Professors

Visiting Professor
IMURA, Kohei *(from Waseda University)*

Development of Advanced Super-Resolution Microscopy and Their Application to Nanomaterials

Near-field optical microcopy overcomes the diffraction limit of light and achieves a nanometer spatial resolution. We have developed various near-field spectroscopic methods such as transmission, non-linear excitation, ultrafast time-resolved imaging, and utilized them to study optical properties of nanomaterials. We have been extending these studies into two directions: (1) development of advanced super-resolution microscopy based on various microscopes, and (2) spatio-temporal control of elementary excitations and photochemical reactions using nanomaterials. We have developed near-field reflection microscope and cathodoluminescence electron microscope. The microscopy enables to visualize spatial distribution of eigen modes excited in nanomaterials on transparent and non-transparent substrate with a wide spectral range. Recently, we found that optical field distribution excited in the nanomaterials varies with amplitudes and phases of ultrashort pulses illuminated. This indicates that coherent control of elementary excitations and photochemical reactions are feasible in space and time resolved manner. We are currently exploring novel photochemical reaction schemes assisted with designed optical fields.

Visiting Associate Professor
YAMADA, Toyo Kazu *(from Chiba University)*

Dimensional Dependence of Organic Molecular Electronic States

Scanning tunneling microscopy (STM) has been used to visualize material topology with an atomic scale. In last 15 years I have developed STM to visualize not only atomic structures of materials but also electronic, spin, and quantum structures combined with spectroscopy techniques. 1-nm-size nano-materials, such as nano-magnets, single atoms, single molecules, and graphene nano-ribbons have been studied for realizing new nano-electronic devices with low cost, low power consumption, and high performance. In 2015, we glow two-dimensional molecular networks on an atomically-flat noble metal substrate. The surface structures are directly observed by STM. Subsequently, a magnetic metal is deposited on the network, then we can glow new two-dimensional magnetic nano-dot arrays. We study electronic and magnetic structures of the magnetic array by means of STM spectroscopy and the photoemission spectroscopy. All experiments are performed in ultra-high vacuum. We try to control electronic/quantum spin structures of magnetic arrays by using two-dimensional molecular networks.

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

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

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 plan to develop a high-resolution spin- and angle- resolved photoemission spectroscopy measurement system equipped with in situ sample preparation facilities at BL-5U and characterize the novel spin property at the Rashba-split surface/interface states of nonmagnetic ultrathin films.