Visiting Professors

Visiting Professor
TAKENOBU, Taishi *(from Waseda University)*

Electronic Phase Control of Molecular Materials by Electric Double Layer Transistors

Charge carrier control is one of the key issues in the development of solid state physics and novel functional devices. Most famous device is field-effect transistor, in which material conductivity is controlled by accumulated charges at semiconductor/insulator interface. Beyond the simple enhancement of conductivity, high charge carrier accumulation can realize various phenomena, such as phase transition, magnetic ordering, and superconductivity. Electric double layers, formed at solid/electrolyte interfaces, induce extremely large electric fields, huge specific capacitance and high density charge accumulation, and, as the results, this method opens new route for novel functionalities. Because molecular materials have large variety of electronic and magnetic properties, we are investigating the physical properties of ionic liquid/molecular materials interfaces and are developing the method to combine single crystals of molecular solid with electric double layer transistors to discover novel phase transitions and functional devices.

Visiting Associate Professor
NAKANISHI, Takashi *(from National Institute for Materials Science)*

Self-Assembly Controlled Soft Materials of Multifunctional Spin-Active Molecules

Because of optoelectronic properties and single magnet molecule behavior, phthalocyaninato rare-earth metal double-decker complexes have received much attention. These complexes are expected to have application in spintronics as well as in electrochromic and optoelectronic devices. In our work we apply the concept of soft materialization to the double-decker phthalocyanines to achieve control over self-assembly and phase transition of the material. Our aim is to obtain solvent-free soft materials, including room temperature liquids and liquid crystals, with tunable intermolecular interactions and magnetic, electrochromic, and photoconductive properties. One kind of double-decker phthalocyanine is chosen as a “functional, spin-active unit” and multiple branched long-alkyl chains are attached as substituents. The synthesis, spectroscopy and electrochemistry, ESR analyses of these materials as well as their thermotropic behavior are deeply evaluated and further analysis such as electrochromic and photoconductive properties are currently under way.

Visiting Associate Professor
NEGISHI, Yuichi *(from Tokyo University of Science)*

Creation of Functionalized Metal Nanoclusters and Highly Active Photocatalytic Materials Using Thiolate-Protected Magic Gold Clusters

Advances in developments in nanotechnology have encouraged the creation of highly functionalized nanomaterials. Because of their nanoscale size (< 2 nm), thiolate-protected gold clusters ($Au_n(SR)_m$) exhibit size-specific physical and chemical properties not observed in bulk metals. Therefore, they have attracted attention as functional units or building blocks in nanotechnology. The highly stable, magic $Au_n(SR)_m$ clusters possess great potential as new nanomaterials. We are studying the following subjects related to magic $Au_n(SR)_m$ clusters: (1) establishing methods to enhance their functionality, (2) developing high-resolution separation methods and (3) utilizing the clusters as active sites in photocatalytic materials. Through these studies, we aim to create highly functional metal nanoclusters and apply them as highly active photocatalytic materials.