

Visiting Professors



Visiting Professor
SAKURAI, Hidehiro (from *Osaka University*)

Nanoscience Based on the Synthetic Organic Chemistry

Bowl-shaped π -conjugated compounds including partial structures of the fullerenes or the cap structure of carbon nanotubes, which are called “buckybowls,” are of importance not only as model compounds of fullerenes but also as their own chemical and physical properties due to their unique structure. We have developed the rational routes to the various buckybowls, including sumanene, a C_{3v} -symmetric pristine buckybowl framework, and also investigate their chemical and physical properties. We also investigate to develop novel catalytic properties of metal nanoclusters protected by organic polymers and/or molecules. We focus on the following projects: Preparation of size-selective gold and gold-based alloy nanoclusters supported by hydrophilic polymers and its catalytic activity; Development of designer metal nanocluster catalyst using the highly-functionalized protective polymers.



Visiting Professor
UCHIHASHI, Takayuki (from *Nagoya University*)

High-Speed AFM Reveals Accelerated Binding of Agitoxin-2 to K^+ Channel by Induced-Fit

Agitoxin-2 (AgTx2) from scorpion venom is a potent blocker of Shaker-related K^+ channels. Docking model of them has been elucidated; however, whether binding dynamics is described by a two-state (AgTx2-bound and AgTx2-unbound) model or more complicated mechanism such as induced-fit or conformational selection is still unclear. Here, we observed the binding dynamics of AgTx2 to the Shaker-mimicking KcsA channel using high-speed atomic force microscopy. We imaged repeated binding and dissociation of AgTx2 to the channel, and found that the affinity of the channel for AgTx2 increases during persistent binding of AgTx2 and decreases during persistent dissociation. We propose a four-state model including high- and low-affinity states of the channel with relevant rate constants. Induced-fit pathway is dominant that accelerates binding event 400 times. This is the first analytical imaging of scorpion toxin binding in real time, which is applicable to various biological dynamics including channel-ligands, DNA-modifier proteins, and antigen-antibody complexes.



Visiting Associate Professor
YAMADA, Teppei (from *Kyushu University*)

Thermocell and Ionic Motion in Soft Molecular Space

Recently we focus on the ionic motion in chiral nanospace. A porous metal-organic framework, Labtb, was synthesized with an enantioselective method. After the collaborative work with Prof. Okamoto and Dr. Narushima in IMS, high enantiomer-excess of Labtb in particle-level was visualized by circular dichroism imaging (*Chem. –Eur. J.* **10**, 6698–6702 (2019)). The obtained enantiomeric Labtb is highly stable from heat, chemicals and has 1D pore of ca. 13 Å in diameter, and we are searching the wide application of it.

I also intend to control the behavior of redox species by temperature response for constructing next-generation thermocell. Host-guest chemistry, (*Bull. Chem. Soc. Jpn.* **92**, 1142–1147 (2019); *Polymer J.* **50**, 761–769 (2019); *Chem. Sci.* **10**, 773–780 (2019)) and the chemistry of polythiolate (*ChemSusChem* **12**, 4014–4020 (2019)) were applied and high Seebeck coefficient was observed.