Visiting Professors

Visiting Professor
TANAKA, Koichiro *(from Kyoto University)*

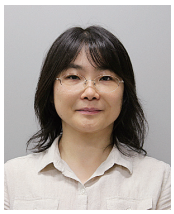
Ultrafast Laser Spectroscopy and Terahertz Optical Sciences

In recent years, the technology of ultra-short lasers and terahertz light has made remarkable progress, revealing unprecedented ultra-non-equilibrium physics and order formation of solid materials under high-intensity light irradiation. We make full use of such state-of-the-art optical technology to study the excited state dynamics of semiconductors, single-layer materials, photonic crystals, and metamaterials, as well as "non-equilibrium physics under high-intensity light fields." We are also looking for ways to bring out new physical properties by utilizing the interaction between light and matter. Specific research topics include (1) elucidation of non-equilibrium physical properties of solids in high-intensity light fields, (2) research on ultrafast nonlinear phenomena using ultrashort pulse lasers, and (3) new spectroscopy using terahertz light, (4) optical properties of monoatomic layer materials, (5) research on exciter quantum effects in semiconductors, *etc*.

Visiting Professor
OSAKA, Itaru *(from Hiroshima University)*

π-Conjugated Polymers for High-Efficiency Organic Photovoltaics

Organic photovoltaics (OPVs) have been attracting much attention due to lightweight, flexible, low-cost and low-energy solution-processability. Improving the power conversion efficiency is one of the important issues in OPVs. We designed and synthesized a series of π-conjugated polymers based on an extended fused ring, named dithienonaphthobisthiadiazole. The polymers had rigid and coplanar backbone structure, which resulted in high-crystalline structure in the thin film. The efficiency of the photovoltaic cells was as high as 12% when one of the polymers was combined with a fullerene acceptor, which was among the highest values for polymer/fullerene cells. Importantly, extremely high fill factors of over 0.8 were obtained, which was likely ascribed to the high charge carrier mobility. In addition, when another dithienonaphtobisthiadiazole-based polymer was combined with a nonfullerene acceptor, it showed high efficiencies of over 18%. Moreover, the polymer showed high photocurrent generation even with very small driving force energy. These results would be important guidelines for the development of high-performance polymers.



Visiting Associate Professor
AKIMOTO, Ikuko *(from Wakayama University)*

Pulse EPR Study of Photo-Induced Paramagnetic Centers in Solid Electrolyte $BaZr_{1-x}M_xO_3$ (M = Sc, Y)

Barium zirconate $BaZrO_3$ doped with trivalent metal ions (M = Sc, Y) is a promising candidate for solid electrolytes for proton transport in fuel cells. The oxygen vacancy is noted to be a key structure for accepting hydroxyl groups and transferring protons via the Grotthus Mechanism. However, it has been challenging to investigate the local structure of oxygen vacancies using conventional methods in the ion transport field. We found that ultraviolet (UV) irradiation induces paramagnetic centers, so-called F-centers, *i.e.* electrons bound to oxygen vacancies. Then, we can apply well-established electron paramagnetic resonance (EPR) techniques to this system to elucidate the fine structure through the magnetic interactions. We performed time-domain EPR measurements under UV light irradiation at cryogenic temperatures and investigated the shape of EPR spectrum, the spin multiplicity of the signal, and the hyperfine structure buried in the broadened spectral width. Based on the results that depend on the doped ion species and hydroxyl contents, we clarify the local structure in conjunction with EPR simulations.