Visiting Professors

Visiting Professor
MASE, Kazuhiko *(from High Energy Accelerator Research Organization)*

Development of New Nonevaporable Getter (NEG) with a Low Activation Temperature

Nonevaporable getter (NEG) is a functional material that evacuates residual gases at room temperature (RT) by forming an active surface when heated in ultra-high vacuum (UHV). When NEG is deposited on the inner wall of a vacuum vessel, the vacuum vessel will evacuate the residual gases just by baking, and UHV can be maintained without electric power for long time. Therefore, the development of NEG will contribute to CO_2 emission reduction and Sustainable Development Goals (SDGs). However, the activation temperature of NEG (the temperature required to create an active surface by heating in UHV) needs to be lowered if NEG is to be widely used in various vacuum-related industries. Recently we have developed a new NEG, Pd overcoated on Ti thin film with a purity higher than 99.95% (oxygen-free Pd/Ti hereafter), which evacuates H_2 and CO at RT after baking at 133 °C for 12 hours. NEG pumps using oxygen-free Pd/Ti deposition has been commercialized in 2019 and are widely used in synchrotron radiation facilities such as SPring-8, UVSOR, and Photon Factory.

Visiting Associate Professor
FUKUHARA, Takeshi *(from RIKEN)*

Single-Atom-Resolved Imaging of Quantum Gases in Optical Lattices

Ultracold quantum gases in optical lattices provide a clean and controllable platform for studying quantum many-body systems; especially they enable us to emulate various fundamental models in solid-state physics. Key technologies for this research are the detection and manipulation of such gases at the single-atom level. We have prepared quantum gases in triangular optical lattices for the study of frustration physics and successfully realized single-atom-resolved detection using fluorescence imaging. Raman sideband cooling has been utilized for the detection because the sample of ultracold atoms is heated and destroyed due to photon scattering. Several parameters, such as intensities and frequencies of the cooling lasers, are required to be tuned for successful imaging. We automatically adjusted the parameters using Bayesian optimization, which is a machine learning method. Now we are improving the scheme for the optimization method to enhance the imaging fidelity.

Visiting Associate Professor
NAKAYAMA, Yasuo *(from Tokyo University of Science)*

Epitaxially-Grown Single-Crystalline Organic Molecular Semiconductors

While epitaxial growth of single-crystalline (inorganic) semiconductor materials is one of the most essential technologies for modern electronic applications, current organic semiconductor electronics are mostly built on heterojunctions composed of polycrystalline or amorphous molecular solids. On the other hand, single-crystalline organic semiconductor materials exhibiting “band transport” realize considerably high charge carrier mobility of over 10 $cm^2V^{-1}s^{-1}$ and have potential applications as flexible and efficient electronic devices. Our group has been working on single-crystalline heterojunctions of organic molecular semiconductors by epitaxial growth techniques. Recently, we discovered as a collaborative work with IMS groups that a methyl- and trifluoromethyl-substituted derivative of rubrene forms high-quality single-crystalline junctions on the single-crystal surface of (unsubstituted) rubrene in a “quasi-homoepitaxial” manner. Electronic band measurements on this quasi-homoepitaxial molecular junction by means of angle-resolved photoelectron spectroscopy are one of our next targets.