

Introduction of Condensed Matter Research Center, IMSS
and
the Research on Molecular Ensemble System
using Resonant X-ray Scattering

Youichi Murakami

Department of Physics, Graduate School of Science, Tohoku University

The Condensed Matter Research Center (CMRC) will be established in the Institute of Materials Structure Science (IMSS), the High Energy Accelerator Research Organization (KEK) in April 2009. In IMSS, Photon Factory (PF) provides photons with a wide energy range (VUV, soft and hard x-rays) and unique instruments. X-rays are very powerful to understand nano-scale materials structure (atomic positions and electron distribution), while VUV and soft x-rays give the information about the electronic structure of materials. We need both pieces of knowledge to study the basic structure of materials. KEK also provides forefront sources for neutrons and muons in the J-PARC facility jointly with Japan Atomic Energy Agency (JAEA). We understand the importance of the complementary use of photon, neutron, and muon when we want to get the deeper understanding of materials. The mission of the CMRC is to make forefront and pioneering researches in strategically selected areas of materials science using these multi-probes. It is also important for the scientific achievement to collaborate with dominant universities and research institutions, especially, RIKEN and JAEA (Japan Atomic Energy Agency). We are now planning the scientific programs, which will be strongly developed at CMRC. The best programs will be selected from a broad range of scientific disciplines. In this stage we are thinking four material systems for the programs: 1. functional materials in strongly correlated electron systems where the keywords are charge, spin, orbital orderings and frustration, 2. surface and interface structure used in spintronics, 3. functional soft-matter and bio-matter of living organism, 4. Materials under extreme conditions like high pressure and strong magnetic field. We would like to take world leadership in these important areas for condensed matter studies by the cooperation with the user community.

In the latter of my talk, the research on the molecular ensemble system using resonant x-ray scattering (RXS) will be proposed. The RXS is very powerful tool to study the orderings of electronic degrees of freedom (charge, spin, and orbital) in strongly correlated electron systems. We can study the relation between the orderings and electronic, magnetic properties (metal-insulator transition, magnetism, and superconductivity etc.). We are planning to study π -d molecular system like $M(\text{dmit})_2$ where we may get the information from the RXS using the absorption edges of the M ion and sulfur to elucidate the relation between the valence-bond solid and the superconductivity.