Condensed Matter Research Center
Overview

Youichi Murakami, Head of CMRC

The Condensed Matter Research Center (CMRC) was established on April 1, 2009, at the Institute of Materials Structure Science (IMSS) with the aim of pursuing cutting-edge research on condensed matter science through the comprehensive use of multi-probes supplied by the IMSS, such as synchrotron light, neutrons, muons, and slow positrons. The CMRC has four research groups: the Correlated Electron Matter Group, the Surface/Interface Group, the Matter Under Extreme Conditions Group, and the Soft Matter Group. Through collaboration among these four groups, the CMRC has been promoting six bottom-up projects: the hybridized orbital ordering project, geometrical correlation project, molecular crystal project, surface/interface project, extreme condition project, and soft matter project. In the hybridized orbital ordering project, both the hybridized orbital ordering between localized and itinerant electrons and the charge/spin/orbital orderings have been studied under high pressure or a strong magnetic field. In the geometrical correlation project, we have determined the characteristic correlation time for fluctuation in itinerant systems with strong electron correlation under the influence of geometrical frustration using muons, neutrons, and synchrotron X-rays, which have different probing-time scales. In the molecular crystal project, electronic correlation in molecular crystal systems has been investigated to elucidate novel phenomena such as superconductivity, magnetism, ferroelectricity, and charge ordering. In the surface/interface project, crystal structures and electronic structures at the surface and interface of magnetic thin films and multilayers have been studied through depth-resolved magnetic circular dichroism (MCD)/X-ray absorption spectroscopy (XAS), resonant X-ray scattering (RXS), and neutron reflectivity. In the extreme condition project, we have studied changes in the crystal structures, electronic structures, spin states, valence states, and chemical bonding of important compounds in geophysics to understand changes in their density and elastic, geological, transport, and chemical properties. In the soft matter project, we have investigated spontaneous motion under non-equilibrium conditions, the hierarchical structure of a soft matter complex resulting from self-organization, and functional soft matter interfaces for industrial applications.