Materials Science:


"Fuji" - *Wisteria*

A variety of spectroscopic and light scattering studies are performed at SPring-8, covering a wide photon energy range from the infrared to hard-X-ray region with high energy and high momentum resolutions. Such studies provide important information on the electronic and magnetic properties of functional materials.

The performance of hard-X-ray scattering methods such as inelastic and Compton scattering at SPring-8 is very high and these methods are now applied to the investigation of many kinds of materials. H. Sakai and co-workers successfully synthesized a high-quality single crystal of perovskite $Sr_{1-x}Ba_xMnO_3$. They obtained high-resolution phonon-dispersion data by inelastic X-ray scattering at BL35XU. The ferroelectric transition related to a soft phonon was clearly observed.

High-resolution Compton profiles taken at BL08W show drastic changes in the electronic structures of materials associated with phase transitions. Y. Sakurai and K. Yamada clearly showed the difference between the electronic structures of a cuprate superconductor in the underdoped and overdoped regions. A change in electronic structures from the itinerant to the localized states in heavy-fermion Ce compounds was observed by A. Koizumi. The images of electron occupation number density are rich in information concerning the properties of such materials.

Electronic & Magnetic Properties

Investigations of magnetic materials are also very active at SPring-8. Recently, activities combined with microscopic techniques habe become important. In addition, studies under extreme conditions are required. An unexpected magnetic nature in high-pressure phase β(fcc)-Co was found by the hard-X-ray magnetic circular dichroism (MCD) technique at BL39XU. N. Ishimatsu successfully observed the X-ray absorption spectra and dichroism signals under high-pressure conditions up to 150 GPa. T. Nakamura and Y. Narumi succeeded in developing a high-magnetic field (~30 T) MCD at the soft-X-ray beamline BL25SU. Because MCD in the soft-X-ray region has the advantage of direct probing of the 3*d* bands of transition metals and the 4*f* bands of the rare earths, the development is very important for further studies for a variety of magnetic materials.

Hard-X-ray photoemission spectroscopy (at BL15XU, BL29XU, BL46XU and BL47XU), HAXPES, provides accurate bulk and interface information of materials. Recently, excitation by polarized-X-ray is widely utilized. G. Fecher demonstrated the linear and circular dichroism effects in angle-resolved HAXPES of Heusler compounds at BL47XU. The methods will be widely applied for the investigation of the properties of magnetic multilayers and especially of their buried interface.

Y. Takeda studied the bonding nature of aluminum hydride, which is known as a hydrogen storage material, using soft-X-ray absorption and emission spectroscopy at BL27SU. He showed the covalent nature of Al-H bonding. The applicability of the absorption and emission spectroscopy for such insulating materials with large band gaps is essential.

Other new developments and activities in the field of spectroscopy are in progress at SPring-8. These frontiers are expected to be introduced in the near future.

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