MATERIALS SCIENCE:

One of the most important missions in materials science is the finding of new phenomena/states, leading to novel properties/functions. In the section "Materials Science: Structure," outstanding research on finding new states (by Yamaura *et al*. and Shibauchi *et al*.), new phenomena (by Seto *et al*. and Moriyoshi *et al*.) and new composites (by Sato *et al*.) by utilizing the advanced measurement and analysis technology available at SPring-8 is introduced. In addition, a new phenomenon that will be developed to a new analysis method (by Matsui *et al*.) is also introduced.

Studies on ordered states such as magnetism and superconductivity have been intensively conducted, and they are still hot topics because of their complexity. For the realization of robust ordered states and of those with high transition temperatures (most ordered states appear at low temperatures), attempts at unveiling the hidden mechanism of complex ordered states have been conducted. Yamaura *et al*. found a new type of three-dimensional spin arrangement as an ordered state, the so-called all-in/all-out configuration, by the resonant X-ray magnetic scattering method (RXMS), while simple parallel and antiparallel configurations have mainly been discussed as ordered states so far. Shibauchi *et al*. have succeeded in the visualization of nematic ordering, which is well known in liquid crystals, in the electronic phase of novel iron-based superconductors by means of the extremely high-q (q: scattering vector) diffraction measurements, and it has been demonstrated that advanced synchrotron radiation analysis is a powerful tool for understanding the electronic nematicity in condensed matter.

STRUCTURE

The dynamics of matter is inseparable from the discussion of novel properties and functions. In 1995, P. W. Anderson wrote that *the deepest and most interesting unsolved problem in solid-state theory is probably the nature of glass and the glass transition*. Seto *et al*. have developed an approach to reply to this message from the viewpoint of the dynamics of glass, and propose a new regime of slow dynamics of glass on the basis of time domain interferometry (TDI) using nuclear resonant scattering (NRS) measurements. Moriyoshi *et al*. have taken a different approach, time-resolved X-ray diffraction, to unveiling the dynamics of matter, and succeeded in the direct observation of lattice dynamics in piezoelectric materials.

Sato *et al*. developed a method to encapsulate individual protein molecules into a molecule with a hollow spherical cage structure through the full use of organic chemistry, and a composite structure consisting of chemical and biological molecules was visualized by the maximum entropy method using high-precision synchrotron radiation X-ray diffraction data. It is expected that the interdisciplinary research involving chemistry, biology and structural science will accelerate the design and control of functional molecules.

The above-mentioned progress in materials science is due to advanced synchrotron radiation measurements. The germ of a new analytical method, the tone reversal image from the negative photographic photoelectron energy-loss process, was found by Matsui *et al*., and this new phenomenon is being developed as a new measurement tool.

In 2012, highlighted research in materials science was carried out in a wide range of research fields, such as physics, chemistry, biology, and interdisciplinary areas, by means of many kinds of measurements. In the future, approaches from many points of view, such as multiple beamline use, will be indispensable in the development of materials science.

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