Chemical

Synchrotron-radiation-related science, including accelerator, light source, beamline, monochromator, and X-ray imaging optics technology have undergone intense development over the past three decades. Cutting-edge X-ray science and technology is concentrated at synchrotron radiation facilities such as SPring-8, enabling synchrotron radiation experiments at the highest level. The hospitality to users is also excellent, providing an ideal environment even for non-specialists. Excellent research was conducted at all of the beamlines in 2009, and we introduce here some special topics in the field of chemical science.

The research team of Professor Ueda at Tohoku University have investigated C1*s* photoemission from CO_2 molecules, carrying out electron-ion coincidence momentum-imaging measurements at BL27SU. The first evidence for excitation by internal inelastic scattering was found. In this process, a photoelectron and a valence electron collide, resulting in one of them being promoted and the other ejected. The research team of Professor Shin, The University of Tokyo/RIKEN, has studied liquid water by applying X-ray emission spectroscopy (XES) using a liquid flow cell at BL17SU, revealing two different structures. Small angle X-ray scattering (SAXS) showed that the density of the hydrogen-bond distorted structure decreased and approached that of the tetrahedral-like structure with increasing water

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temperature. A comparison of the results revealed fluctuations between the two structures. The XES method has also been used to study acetic acid in an aqueous solution under ambient conditions at BL17SU. Here, Professor Shin' s group concluded that the anionic and neutral forms of acetic acid do not interact with each other, and only the population of the two components depends on pH. This method promises to be a powerful tool for the study of biological and chemical systems. Professor Sakurai *et al*. of The University of Kitakyushu have developed a new drug-delivery system (DDS) technique at BL40B2, integrating nanotechnology with biology, chemistry, and polymer science. They used SAXS to study DNA/cationic lipid, DNA/polysaccharide, and hydrophobic-drug/polymer micelles, and to correlate their pharmacological efficiencies and particle-inner structures. The research team of Professor Kitagawa at Kyoto University has demonstrated the synthesis of hybridized porous coordination polymer (PCP) crystals. The structural relationship between the shell crystal and the core crystal was determined using X-ray diffraction at BL13XU. The results showed that the shell crystal grows as a single crystal on the core crystal. Crystals with different adsorption and separation properties can thus be integrated into a single crystal, resulting in "multi- functional PCPs." Prof. Makiura *et al*. of Kyushu University have synthesized poly-*N*-vinyl-2-pyrrolidone (PVP)-coated AgI nanoparticles, and studied them using temperature-dependent X-ray powder diffraction at BL02B2. PVP can be used as a stabilizer to isolate new families of nanoscale (super) ionic conductors with controlled sizes and morphologies, promising new applications in nanobatteries and other electrochemical devices. Professor Hosono *et al*. of Tokyo Institute of Technology have succeeded in the synthesis of new Fe-1111 type compounds in which the $(LnO)^{\delta+}$ layers in *Ln*FeAsO are replaced by $(AeF)^{\delta+}$ layers. X-ray powder diffraction studies at BL02B2 confirmed that the tetragonal to orthorhombic crystallographic transition occurs in the *Ae*FeAsF system, and revealed the relationship between T_c and the crystal structure. CaFeAsF was shown to be a promising high-T_c superconductor. Professor Masuno *et al*. of The University of Tokyo have investigated the structures of glassy $BaTi_2O_5$, fabricated by a containerless method by combining X-ray diffraction results from BL04B2 with neutron diffraction, X-ray absorption near-edge structure (XANES) analyses, and computer simulations. The results showed that the glass-forming ability was enhanced by the containerless processing. Professor Haines *et al*. of Université Montpellier II have determined the structure of amorphous silica obtained from the pressure-induced amorphization of pure SiO_2 zeolite, silicalite-1-F. High energy total X-ray scattering data were obtained at BL04B2. The structural topologies of the new material were compared to those of amorphous silica obtained by temperature-induced vitrification.

Yuden Teraoka