Life Science
Structural Biology

Biological macromolecules (proteins, nucleic acids, and carbohydrates) play leading roles in the processes of living cells and attract much of the attention of scientists. In particular, successes in structural biology research on proteins and protein-nucleic acid complexes are notable, providing their remarkable structures as the basis of fine-tuned complicated functions. In addition, many genome analyses, including the Human Genome Project, have provided much genetic information, including the amino acid sequences of proteins. Thus, structural biology research becomes increasingly important for elucidating the three-dimensional structures and functions, and Structural Genomics projects as postgenomic research are progressing worldwide.

Synchrotron radiation (SR), particularly the third generation SR, is now indispensable for structural biology and structural genomics research. At SPring-8, five undulator and seven bending magnet beamlines have been contributing in the field of macromolecular crystallography, small angle X-ray scattering (SAXS) and fiber diffraction studies. A large format CCD detector (ADSC Quantum 315), which enables high-throughput data collection with a higher resolution than previous detectors, was installed at BL41XU. Moreover, a standardized user-friendly beamline control system (BSS) was installed for a more efficient data collection in many beamlines.

Many new structures of biologically important macromolecules were determined by crystallography last year. The structural determination of all four principal states in the calcium pump has been completed, elucidating the gating mechanism that underlies release of the calcium ions into the lumen. The structure of the MexAB-OprM pump assembly, which crosses the inner and outer membranes, gave insight into the mechanism of multidrug efflux. The precise structural analysis of cytochrome *c* oxidase revealed a redox-coupled conformational change, on the basis of which the mechanism of the proton-pumping process was proposed. The structure of the clock oscillator protein KaiA led to the identification of the crucial residue for circadian rhythms, the daily activity cycles. The structures of the human DNA recombinase Dmc1 and elongation factor P from *Thermus thermophilus* HB8 brought breakthroughs in the studies of cell division and genetic translation process. The conversion of iron-sulfur clusters was shown by aerobic and anaerobic structures of ferredoxin.

SAXS and fiber diffraction were applied to the study of nanoscale molecular structures. The dynamical study of apo-myoglobin folding provided insight into protein-folding trajectory, and wide-angle X-ray scattering study led to the construction of the hierarchical map of unfolding-refolding transition of proteins. The fiber diffraction study of prion Sup35 amyloid fibers revealed the β-helix backbone as the core structure.

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