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Advanced X-ray bioimaging technology for structural genomics

Advances in X-ray technologies have contributed to the development of structural biology and life sciences. In this research, the principles underlying the central dogma of life will be clarified by structure-based analyses of nucleic acids and their related enzymes, involved in tRNA maturation and ribosomal translation, as the key elements for the genetic and protein composition systems. X-ray crystallography is the one of most important core technologies for protein structural analysis. Recent progress in protein microcrystallography now allows us to analyze extremely small crystals that have grown poorly or suffer from rapid radiation damage. In addition, the further technological development of the X-ray Free Electron Laser (XFEL) is expected to enable the observation of the structural fluctuations of proteins in solution or in the transition states of certain reactions. XFEL has the potential to facilitate bio-molecular imaging in solution in very short times, with accuracy on the ten-femto-second order. We have successfully obtained genuine coherent X-ray speckle patterns from living bacterial cells, as well as from purified gigantic bio-molecules, such as ribosomes. High-quality coherent X-ray diffraction patterns were recorded from intact *Microbacterium lacticum* cells. An image re-constructed from the X-ray diffraction pattern revealed the natural nanoscale structures within live cells, thus providing clues toward understanding nucleoid structures, which are inaccessible by other methods. The technologies of this research will potentially create breakthroughs in whole cell biology, and contribute toward single-molecule imaging in the future with XFEL. Through structural and functional analyses, as well as basic research in bio-imaging, the entire networks of the molecules could be revealed in the future, as the complete cellular system. We will discuss the recent results of our projects in this presentation.

Biography

Yoshitaka Bessho is a Structural Biologist recognized in the field of Nucleic Acid and Protein Research, with a particular focus on tRNA and the genetic code. He served as an Assistant Professor at Nagoya University, Japan in 1992. After his service as a Japanese Governmental Overseas Research Fellow at SUNY Buffalo in 1998-99, he moved to RIKEN Yokohama Institute in 2001 as a Researcher for Protein Structural projects. Since 2009, he has served as the Team Leader of the Functomics Biology group at RIKEN SPring-8 Center, Japan. He is now a Visiting Professor at Academia Sinica, Taiwan, seeking to promote international collaboration projects between Japanese/Taiwanese synchrotrons. His research is focused on developing structure-based system biological science, and he is engaged in the technical development of the synchrotron and the XFEL (X-ray Free Electron Laser). In addition, he is a Founder of the Japanese Society for the study in origin and evolution of primary biomaterials for common cellular activities. His achievements include research in the origin and the evolution of the central dogma of life.

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