Okazaki Institute for Integrative Bioscience

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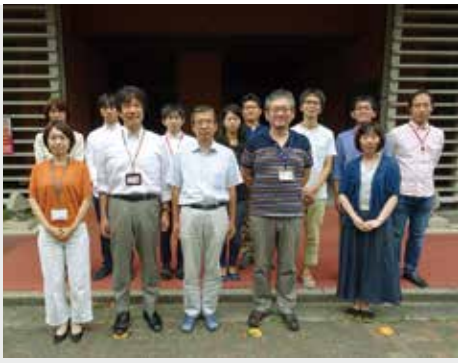

The main purpose of Okazaki Institute for Integrative Bioscience (OIIB) is to conduct interdisciplinary, molecular research on various biological phenomena such as signal transduction, differentiation and environmental response. OIIB, founded in April 2000, introduces cutting edge methodology from the physical and chemical disciplines to foster new trends in bioscience research. OIIB is a center shared by and benefited from all three institutes in Okazaki, thus encouraging innovative researches adequately in advance of academic and social demands. OIIB has started the research programs, "Okazaki ORION Project" and "BioNEXT Program" from 2014. The research groups of three full professors and one associate professor who have the position in IMS join OIIB to be involved in these research projects. The research activities of these groups are as follows.

Aono group is studying the bioinorganic chemistry of metalloproteins that show a novel function. Their research interests are focused on the structure and function relationships of transcriptional regulators and metal transport proteins that are responsible for metal homeostasis, especially iron and/or heme homeostasis, in bacteria. They are also working on a novel photosensor protein that adopts vitamin B_{12} (adenosylcobalamin) as the active site for photosensing, which is a transcriptional factor regulating gene expression in response to visible ligth. They successfully determined the crystal structures of HtaA, HtaB, and HmuT that are heme-binding and heme-transport proteins responsible for heme uptake reaction in *Croynebacterium glutamicum*. They also determined the crystal structure of a novel photosensor protein CarH from *Thermus thermophilus*, which uses adenosylcobalamin as a photoreceptor. Iino group is studying operation and design principles of molecular machines using single-molecule analysis, structural analysis, and protein engineering. Especially, they focus on rotary and linear molecular motors. In this year, they have succeeded in direct observation of 1-nm stepping motion of a linear molecular motor chitinase A moving on crystalline chitin. They also have revealed that chitinase A operates as the Brownian ratchet, and decrystallization of single polymer chain from the crystal is the rate-limiting step of the processive movement of chitinase A. Furthermore, as protein engineering approach, they have determined the crystal structures of computationally redesigned functional chitinase A molecules. Kato group is studying structure, dynamics, and interactions of biological macromolecules using nuclear magnetic resonance (NMR) spectroscopy, X-ray crystallography, and other biophysical methods. In particular, they conducted studies aimed at elucidating the dynamic structures of glycoconjugates and proteins for integrative understanding of the mechanisms underlying their biological functions. In this year, they successfully characterized conformational dynamics of a high-mannose-type oligosaccharide with a critical determinant recognized by molecular chaperones and also created self-assembled glycoclusters exhibiting homophilic hyper-assembly in a Ca^{2+}-dependent manner through specific carbohydrate–carbohydrate interactions. Kurihara group is studying artificial chemical cells consisted of supramolecular assemblies, *e.g.* vesicle, oil droplet. Their goal is to create artificial cells which has three main elements: Information, compartment and metabolism (protein). They achieved the self-reproducing oil droplet system, which lead to the formation of giant vesicular compartment. In this year, by developing the self-reproducing oil droplet system, they are constructing vesicular system containing oligopeptides which are spontaneously generated by native chemical ligations.