

**The System-Biological Project of a Model Organism, *Thermus thermophilus* HB8:
Frontier Light for the Central Dogma of Life.**

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As a model organism for structural and functional studies, the extremely thermophilic bacterium, *Thermus thermophilus* HB8, is promising, because of its small genome size (2.1 Mbp), the availability of genetic tools for functional analysis, and the thermostability of its proteins. To understand the whole biological phenomena on the basis of the structures and functions of all of the molecules in the cell, we are obtaining functional information on a genome-wide scale, by using bio-imaging methods and analyzing mRNA expression (transcriptomics), protein expression (proteomics) and metabolite dynamics (metabolomics). For whole-cell imaging, structural information for each molecule will be very useful. Therefore, we have determined the structures of as many proteins as possible. The structures of over 21% of the total proteins (about 460 proteins) in this model organism have already been determined. Among the 2,238 protein genes within the organism, more than 1,800 plasmids for protein expression and 1,000 plasmids for gene disruption have been constructed and distributed to the public through the RIKEN Bio-Resource Center. The protein expression, purification, crystallization, structure, and functomics results are also available on our homepages [1] and in the public databases.

The research project is to accomplish the complete elucidation of the cellular systems, through structural and functional analyses. We are focusing on "DNA-repair" systems, and "protein-synthesis (translation)" system, as essential cellular processes in the central-dogma of life. A vast amount of DNA damage occurs from UV radiation, various chemical reagents, and errors during DNA replication. To remove these lesions, cells have various types of DNA-repair systems. Translation is a compiling system, from the genetic information of the DNA to the amino-acid chain of the protein. The translator, tRNA, is a key molecule of the protein-synthesis system, and thus we are also focusing on the enzymes related to tRNA maturation and aminoacylation. In addition, as an example of a ribosomal system of translation, a quality-control system has been extensively analyzed in the project. Through structural and functional analyses as well as basic research in bio-imaging, the whole networks of the molecules could be revealed in future, as the complete cellular system. Thus, we are developing bio-molecule imaging technologies, by using the innovative light sources in the SPring-8 synchrotron, which enables the effective use of the X-ray free electron laser (XFEL), near future. We will discuss the recent results of our projects in this presentation.

[1] *Thermus thermophilus* HB8, Structural-Biological Whole Cell Project::

http://www.thermus.org/e_index.htm