

## Interdisciplinary Area



### Title of Project : Synthetic Biology for the Comprehension of Biomolecular Networks

**Masahiro Okamoto**

(Kyushu University, Graduate School of Systems Life Sciences,  
Professor)

#### 【Purpose of the Research Project】

In order to make the paradigm shift from the concept of “watched and analyzed biology” to that of “synthetic and analyzed or utilized biology”, the innovative research named *Synthetic Biology* was started from 2000 in US, such as designing synthesized genetic circuit by combining known interrelated biomaterials, realizing a certain bio-functional behaviors such as switch, oscillation, *in vivo*, designing artificial metabolic pathways by incorporating genes coded enzyme from other origins into the cells. However, these attempts have been done on a small scale and with a trial-and-error method. The objectives of this research project is to establish the coordination between the fundamental technologies for synthetic biology in order to comprehend biomolecular networks by integrating the following three missions: 1) design artificial genetic circuit or metabolic pathway with using the methods of computational science, 2) construct the circuit *in vitro* with using the method of engineering, 3) construct the circuit *in vivo* or in the cell with using the methods of molecular biology.

#### 【Content of the Research Project】

In order to construct and control a large scale of dynamic and complex artificial genetic circuit or metabolic pathways, the fundamental technologies for synthetic biology are essential as shown in Fig. 1. In the first stage (2-3 years), our mission is to construct dynamic and multi-elements synthetic genetic circuit, followed by the construction of differentiation-induced system against stem cell and by the realization of cell factory, in which cells can produce the target metabolites by themselves according to the cell environment in the last 2-years.

The research project is composed of the following four sub sections: (A01) fundamental technologies of molecular biology (experimental works), (B01) fundamental technologies of engineering (experimental works), (C01) fundamental technologies of computational science (theoretical works) and (X01) integrated section of A01, B01 and C01.

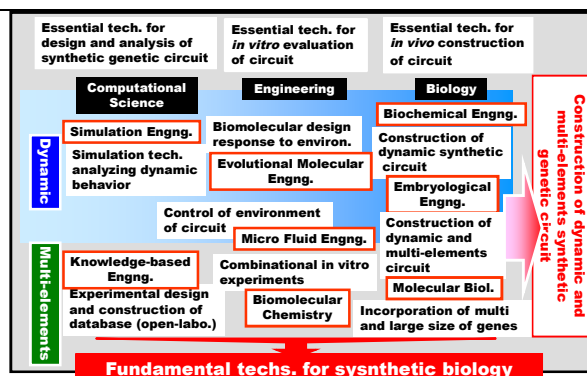


Figure 1 Fundamental technologies for synthetic biology

#### 【Expected Research Achievements and Scientific Significance】

In order to scale up artificial genetic circuits and metabolic pathways, we have to establish the effective coordination of fundamental technologies lying in computational science, engineering and molecular biology. The conventional research in biology is so-called “watched and analyzed biology”. Contrary to this, the synthetic biology is so-called “synthetic and analyzed or utilized biology”. By constructing and incorporating interrelated artificial genetic circuits and artificial metabolic pathways into cells, we can comprehend biomolecular networks from the different view.

#### 【Key Words】

synthetic biology, artificial genetic circuit, artificial metabolic pathways, simulation technology, knowledge based information science, evolutionary molecular engineering, biomolecular chemistry, biochemical engineering, embryological engineering, molecular biology

【Term of Project】 FY2011-2015

【Budget Allocation】 880,300 Thousand Yen

#### 【Homepage Address and Other Contact Information】

<http://www.syn-biol.com>  
okahon@brs.kyushu-u.ac.jp