Re-design and Synthesis of Yeast Chromosome

H. Kurasawa, H. Yamashita and Y. Aizawa
DSchool of Life Science and Technology, Tokyo Institute of Technology, Japan
e-mail: kurasawa.hikaru.jr@gmail.com

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Genome is information material, including all the pieces of genetic information that are required for an organism to be born, to grow, to propagate and to die. In an industrial sense, genome has been recognized as a blueprint that drives production of natural materials in living cells by controlling expression of genetic information coded in the genome sequence, which has been long seen in fermentation industry. Recently, thanks to a new genome editing technology, CRISPR/Cas9 system, genome can be manupulated as designed to order the cells to produce even non-natural materials. Nowadays, genome engineering is promised as one of the fields that can transform the industrial scene in near future.

Now, the next-generation genome technology is emerging, so-called, genome synthesis; creating the entire chromosomal DNA from scratch, in sharp contrast to the genome editing mentioned above, where only small parts of genome are modified. Re-designing genome sequences will enable us to create completely novel signaling networks within cells, which has infinite potential to create any biological platforms for any industrial purposes.

Our group has joined the international consortium Sc2.0 (http://syntheticyeast.org/sc2-0/), synthesizing a newly designed genome of budding yeast, *Saccharomyces cerevisiae*, 12.1 M basepairs in length, and creating atrificial yeast cells installed with the man-made genome [1]. Particulary, we Japan team is engaging in synthesis of re-designed synthetic chromosome 4 of the yeast (syn4 chromosome).

In this presentation, we will explain the experimental scheme for genome synthesis, introduce our progress of the syn4 chromosome synthesis and share the potential and advantages of genome synthesis for the future industry.

[1] S.M. Richardson, et al., *Science* 355, 1040-1044 (2017)