CYTOLOGIA
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Meet the author

Interview on 18 February 2022

Yuki Kawanishi (Tokyo University of Science, Japan)

See Kawanisi Y. and Matsunaga S. (2021) *Cytologia* 86, 277-281

What is the self-promotion of the Focus paper and what are the global trends in your research?

I extensively explain the principles of photosynthesis, especially the metabolic pathway centered on RuBisCO (ribulose 1,5-bisphosphate carboxylase/oxygenase). The second half of the paper describes the challenges involved in converting heterotrophic organisms into autotrophic ones and introduces successful cases in *Escherichia coli* and yeast. Against the backdrop of global warming, the global situation has shown that research institutes and companies are moving toward the Sustainable Development Goals (SDGs). The research introduced in this paper aims to realize a carbon-neutral society by converting industrial heterotrophs into autotrophs. In the past, it was difficult to synthesize and edit long DNA strands, but now, with the decline in the price of genome synthesis, it is possible to design and construct new artificial life systems. Therefore, I believe that in the near future, not only *E. coli* and yeast, but also animal cells will be converted into autotrophs. Research in the field of synthetic biology is highly original and contributes to society.

How do you think that the synthetic carbon fixation research will develop in the future? Also, what kind of society will be created if carbon fixation becomes possible in animal or fungus cells in the future?

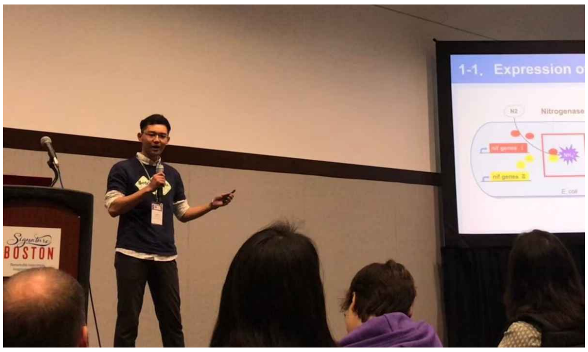
Yuki is checking his constructed cells.

I believe that future research on synthetic biological carbon fixation will be developed from three perspectives. The first is to improve the efficiency of carbon fixation. Currently, in organisms that have been converted from heterotrophs to autotrophs, carbon fixation does not greatly exceed carbon dioxide emissions. It is said that this is because the carbon fixation efficiency of RuiBisCO is very poor. The second is to increase the number of species that can fix carbon. The second is to increase the number of species that can be used for carbon fixation. With the synthetic biology approach, the necessary genes and codon sequences can be arbitrarily designed and constructed according to the species. The third is the development of research in genome synthesis. Information on insertion regions that stably maintain the genomic DNA required for carbon fixation and factors that promote expression and assembly of the transplanted genome will be useful for future research.

If carbon fixation becomes possible in animal cells in the future, I believe that innovations will occur in various fields. For example, CHO-K1 cells are the organism responsible for most of the industrial production of medical proteins, and if they are able to fix carbon, they can contribute greatly to carbon neutrality. In addition, in organoid production and cellular tissue engineering, which are expected to be used in the medical field, nutrient supply to the inside of tissues is an issue, and animal cells that can fix carbon have the potential to solve these problems. I believe that the development of such applications will lead to the realization of the SDGs and the realization of a prosperous society.

You have been strongly interested in synthetic biology since you participated in iGEM. Could you tell us how you became interested in such synthetic biology?

My interest in synthetic biology was sparked by my supervisor, Professor Matsunaga's lecture. The lecture deepened stimulated my interest in synthetic biology. I participated in the iGEM (The International Genetically Engineered Machine competition), a world competition of synthetic biology when I was an undergraduate student. In this competition, I designed and constructed a new biological system by combining standardized genetic parts and created a bacterium that can synthesize amino acids by nitrogen fixation. Our originality and contribution to society were highly evaluated, and we won the Silver Award. Now I am conducting the research on the creation of artificial photosynthetic animal cells, "planimal cells," using a synthetic biology approach. I am experiencing new discoveries and technological advances through the transfer of the huge plant genome into animal cells using cell fusion technology and synthesize photosynthesis-related genes on a genome scale using long DNA synthesis technology.



Yuki with members got the Award at iGEM.