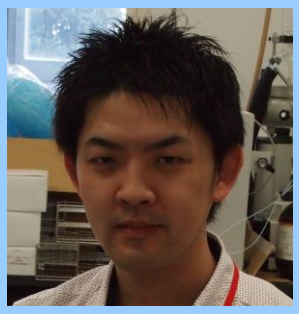
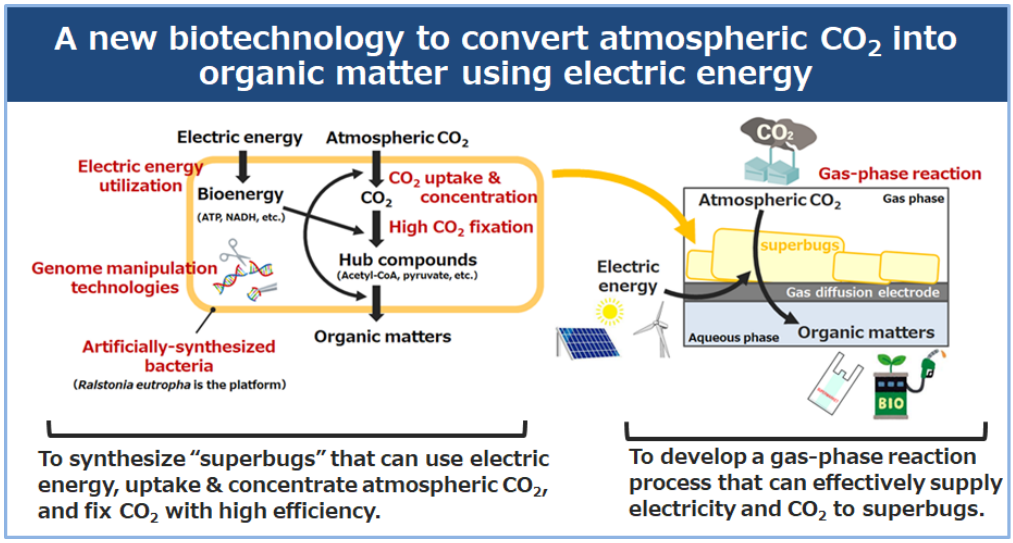


Development of a Bioprocess That Uses Electrical Energy to Fix Atmospheric CO_2

Project Manager（PM）：
KATO Souichiro, National Institute of Advanced Industrial Science and Technology
Contact：s.katou*aist.go.jp
To send an email, please change * to @ in the above email address.

Summary

The ultimate goal of this project is to develop an innovative negative emission technology using microorganisms that can utilize electric energy to convert atmospheric CO_2 into useful organic matter more than 50 times more efficiently than plants. The purpose of this project is to clearly show the feasibility of the novel biotechnology, by artificially synthesizing “superbugs” that can fix atmospheric CO_2 using electricity as the sole energy source, and developing “gas-phase reaction bioprocess” capable of maximizing CO_2 supply to the superbugs. We will use *Ralstonia eutoropha*, a well-known bioplastic producer, as the platform organism. Although basic genetic manipulation tools are available for *Ralstonia*, there are no applicational examples of large-scale genome manipulation. We will develop the basic technology for large-scale genome manipulation and create *Ralstonia* strains with the abilities to utilize electric energy, to uptake and concentrate CO_2 inside of their cells, and to fix CO_2 with high efficiency. Furthermore, we will develop a gas-phase reaction reactor to maximize the capabilities of the artificially synthesized bacteria. The novel reactor should have following three requirements: 1) bacteria are in direct contact with electrodes, 2) bacteria are in direct contact with the gas phase containing CO_2, and 3) bacteria are in direct contact with the aqueous phase containing nutrients. In this project, we will develop a bioreactor that accelerates the electrochemical CO_2 fixation by bacteria, following the technology of chemical fuel cells that realizes the ideal three-phase reaction of gas, solid, and liquid phases.



Targets by 2030

FY2022: The genes required for (1) a current consumption ability, (2) a CO_2 uptake/concentration ability, and (3) a high CO_2 fixation ability will be introduced into *Ralstonia* by genome manipulation technology to generate a strain that simultaneously expresses these three functions. In addition, the CO_2 fixation rate by *Ralstonia* will be improved by using a gas phase reactor and a bio-gas diffusion electrode.

Implementation

National Institute of Advanced Industrial Science and Technology (AIST), Tokyo Institute of Technology, Nagoya University