Abstract

Our aim is to terra-form Mars by bacteria.

In order to realize terra-forming, Tokyo Tech team has particularly focused on Mars as the most feasible planet in the solar system. We designed bacteria which play the role in early stage of terra-forming and proposed the following four tools: 1) iron-oxidizing bacteria 2) anti-freeze protein 3) blackened bacteria 4) bacterial consortium.

As a result, we succeeded in culturing iron-oxidizing bacteria, confirmed the expression of AFP in E.coli, made blackened bacteria, and constructed a simple consortium model.

In conclusion, we provided four basic tools necessary and important for Martian terra-forming, and in the future, we would like to refine the four tools so as for them to be more promising ones for terra-forming.

Introduction

Terra-forming is a part of planetary engineering, modifying extraterrestrial planetary environment to be similar to those on Earth so that the target planet will be habitable for human. Since ancient time till today, Earth has traced on the process, the birth of bacteria, plant, and animal. In our project of terra-forming, we divided our step-by-step approach into two major parts, before and after planting. What should be put an emphasis on is before planting, after planting, all we need is just to trace on the terra-forming process of Earth until today.

The following four approaches are concrete ideas for terra-forming before planting:
1) iron-oxidizing bacteria
2) blackened bacteria
3) anti-freeze protein
4) bacterial consortium

Anti-Freeze Protein

TARGET: Survive at low temperature

The protein inhibits the formation of ice crystal by interacting with it, and therefore lowers the freezing point of water and cytoplasm, which enables E.coli to survive at low temperature.

Bacterial Consortium

TARGET: Master and slave system

Consortium is a group of different bacteria interacting with each other, and a kind of Master and Slave system (Fig D-1).

Purposes and Proposing

The purpose of consortium is division of work, or more specifically, to classify bacteria into two major groups. One (Master) is aimed at producing signal molecules dependent on several stimuli such as heat, light, or other environmental changes. The other (Slave) is aimed at expressing the appropriate protein dependent on the signal molecules so that they can conform to the environment.

In our project, we proposed a simple model for consortium and assayed the activity by constructing the two sorts of Bio Bricks (Fig D-2,3).

Conclusion

Ant-Freeze Protein

What to do
AFP as a BioBrick
Freezing point depression
Examination of freezing tolerance

Iron-Oxidizing Bacteria

What to do
Cultivation of Bacteria
How to select transferred bacteria

Bacterial Consortium

What to do
Establishment of temperature-regulated luxI signaling
How to control specialized bacteria

Blackened Bacteria

What to do
Blackening bacteria with melA as a BioBrick
Association with temperature-regulated luxI signaling

We made the first step in novel approaches no one has ever attempted. Our ambition has just started.