Synthetic Biology Along Bacterial Nanoelectronics

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Background

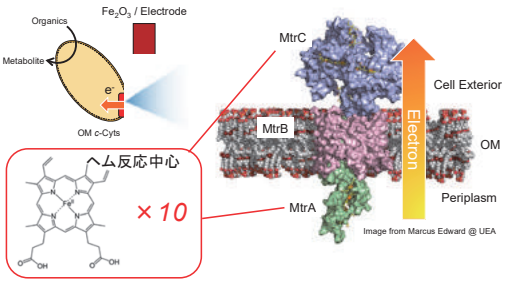
- Nano electron conduit across bacterial insulating membrane (e.g. multi-heme cytochrome)
- Various known bacterial strains are discovered to have the conduit on cell membrane.
- Biological activities that can be electrically controlled give a new view of life

Aim

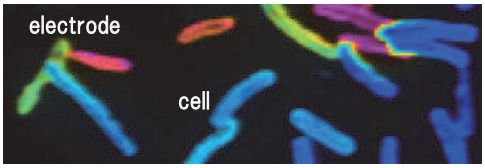
- Reconstruction of bio energy principle by using electrically controllable life.
- Elucidation and control of ionic and electrical properties of the nano-bio-conduit.
- Electrochemical technology for controlling bacterial activity and bacterial sensors.

Advanced Research Topics

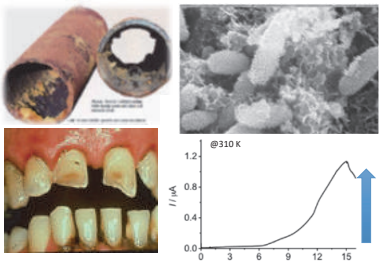
Synthetic biology：Synthetic biology is the design and construction of new biological parts, devices, and systems, and the re-design of existing, natural biological systems for useful purposes and understanding life.



Electron transfer reaction between bacteria and solid material (left) and outer membrane cytochrome enzyme complex with 20 hemes (right). It mediates the electron transfer over 10 nm, but the rate of electron transport was limited by associated proton transfer.



By identifying single cell activity on electrode, we aim to redefine the life by between electron transfer and bacterial energy production.



Electron transport by Iron-corrosive and oral pathogen

Publications

・A. Okamoto, et al. “Proton Transport in the Outer-Membrane Flavocytochrome Complex Limits the Rate of Extracellular Electron Transport” Angew. Chem. Int. Ed. (2017) Vol 56, 9082-9086.
・X. Deng, "Multi-heme cytochromes provide a pathway for survival in energy-limited environments"Science Advances (2018) Vol 4, No.2

Summary

- Proton-transfer-limited electron transfer through the outer membrane cytochrome.
- Extraction of electrons from extracellular electrodes via outer membrane cytochrome by iron corrosion bacteria.

Research outcome

- On-site power supply in dark environment.
- Control of anaerobic bacterial iron corrosion.
- Electrochemical sensor for detecting harmful bacteria.