Engineering electroactive bacteria by synthetic biology strategies

Feng Li
Assistant Professor
School of Chemical Engineering and Technology, Tianjin University
Tianjin 300072, China
messilifeng@163.com; feng.li@tju.edu.cn;

Abstract

Extracellular electron transfer (EET) of electroactive bacteria (including exoelectrogens and electrotrophs) involved bi-directional electron flow and exchange between intracellular and extracellular redox-active electron donors and acceptors. Highly efficient EET of electroactive bacteria is usually a prerequisite for practical applications of versatile bioelectrochemical systems (BES) in energy and environmental fields. However, the EET efficiency of exoelectrogens remained a primary bottleneck. Synthetic biology is a research field that combines the investigative nature of biology with the constructive nature of engineering, which offers great prospects in rationally engineering to facilitate highly efficient EET of electroactive cells. In this talk, based on the molecular mechanisms of EET, i.e., direct-contact via *c*-type cytochromes and shuttle-mediated EET, I will present our recent advances in synthetic biology strategies to enhance the EET efficiency of *Shewanella* or *Pseudomonas*, which included (i) broadening feedstock spectrum via constructing engineered microbial consortia, (ii) strengthening intracellular electron generation via engineering de novo NADH biosynthesis and regenerating NADH by cofactor engineering, (iii) promoting biosynthesis and secretion of electron shuttles such as phenazine and flavins, and (iv) constructing conductive biofilms via regulating the expression of extracellular polymeric substances, such as proteins, polysaccharides, or extracellular DNA. Such synthetic biology efforts in engineering EET efficiency of exoelectrogens could further dramatically boost EET efficiency of and facilitate practical applications of BES systems in future.

Speaker's biography

Feng Li is an assistant professor in biochemical engineering at the Key Laboratory of Systems Bioengineering (MOE), School of Chemical Engineering and Technology, Tianjin University, China. He received Ph.D. in Biochemical Engineering in 2018 from the Tianjin University. After graduation, he joined Tianjin University as an assistant professor. His current research interests are focused on the application of synthetic biology in exploring the extracellular electron transfer mechanism and developing the robust exoelectrogens and synthetic microbial consortia for microbial electrocatalytic processes. He has published over 10 papers and reviews, including *Nature Communications, ACS Catalysis, ACS Synthetic Biology,*

Biotechnology for Biofuels, Catalysis Science & Technology, Current Opinion in Electrochemistry, and Frontiers in Microbiology, etc.

Brief CV

Feng Li, Ph.D.

Assistant Professor

School of Chemical Engineering and Technology, Key Laboratory of Systems Bioengineering (Ministry of Education), Tianjin University

Education:

M.S. Fermentation Engineering, Tianjin University of Science and Technology, China, 2011

Ph.D. Biochemical Engineering, Tianjin University, China, 2018

Research Interests:

1. Exploring the extracellular electron transfer mechanism and developing the robust exoelectrogens synthetic microbial consortia for microbial electrocatalytic processes
2. Microbial photoelectrocatalysis of CO_2 and N_2

Selected publications

1. Zhang, Z et al. ***Catalysis Science & Technology***, 2019, in press.
2. Li, F. et al. ***Frontiers in Microbiology***,2019,10:409
3. Li, F. et al. ***Nature Communications***, 2018, 9: 3637.
4. Li, F. et al. ***ACS Synthetic Biology***, 2018, 7: 885.
5. Chen, X. et al. ***ACS Catalysis***, 2018, 8: 4429.
6. Li, F. et al. ***Current Opinion in Electrochemistry***, 2018, 10: 37.
7. Li, F. et al. ***Biotechnology for Biofue***, 2017, 10: 1600.
8. Li, F. et al. ***Biotechnology Journal***, 2017, 38:148