



Electrocatalytic oxidation of $K_4[Fe(CN)_6]$ by metal-reducing bacterium *Shewanella oneidensis* MR-1

Zheng, Zhiyong; Xiao, Yong; Christensen, Hans Erik Mølager; Zhao, Feng; Zhang, Jingdong

Published in:
Sustain Conference 2018

Publication date:
2018

Document Version
Publisher's PDF, also known as Version of record

[Link back to DTU Orbit](#)

Citation (APA):
Zheng, Z., Xiao, Y., Christensen, H. E. M., Zhao, F., & Zhang, J. (2018). Electrocatalytic oxidation of $K_4[Fe(CN)_6]$ by metal-reducing bacterium *Shewanella oneidensis* MR-1. In C. Melero, & K. Mølhave (Eds.), *Sustain Conference 2018: Creating technology for a Sustainable Society [C-7]* Lyngby, Denmark: Technical University of Denmark.

General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

Electrocatalytic oxidation of $K_4[Fe(CN)_6]$ by metal-reducing bacterium *Shewanella oneidensis* MR-1

Zhiyong Zheng¹, Yong Xiao¹, Ranran Wu¹, Hans Erik Mølager Christensen¹, Feng Zhao², and Jingdong Zhang^{1*}

¹Technical University of Denmark, Department of Chemistry, 2800 Lyngby, Denmark

²Chinese Academy of Sciences, Institute of Urban Environment, 361021 Xiamen, China

*Corresponding author email: jz@kemi.dtu.dk

The microbial metabolic activities between minerals and bacteria play a role on biogeochemical cycling of metal compounds[1]. One of these activities is extracellular electron transfer (EET), in which some microbes exchange electrons with external redox minerals, electrodes or even other microorganisms[2, 3].

In this study, we observed that *Shewanella oneidensis* MR-1 (MR-1) selectively catalyzed the electrooxidation of $K_4[Fe(CN)_6]$ to $K_3[Fe(CN)_6]$. A surprising asymmetric pair of voltammetric peaks is found in cyclic voltammetry (CV) of $K_4[Fe(CN)_6]$ on a MR-1 coated glassy carbon electrode (GCE). The oxidation catalysis is obvious under slow scan rate and low $K_4[Fe(CN)_6]$ concentration. The uniqueness is validated by the exclusion of other microbes and other redox compounds. Extracellular polymer substance (EPS), cytochrome *c*, and riboflavin are not responsible to the asymmetrical redox phenomenon. The antagonistic relationship between the electrooxidation of $K_4[Fe(CN)_6]$ and the formation of Pd nanoparticles by MR-1 indicates that the nanoparticles blocked the pathways of MR-1 to react with $K_4[Fe(CN)_6]$. This study suggests the ability of MR-1 to selectively electrocatalytically oxidize $[Fe(CN)_6]^{4-}$ and its versatile role in biogeochemical cycle.

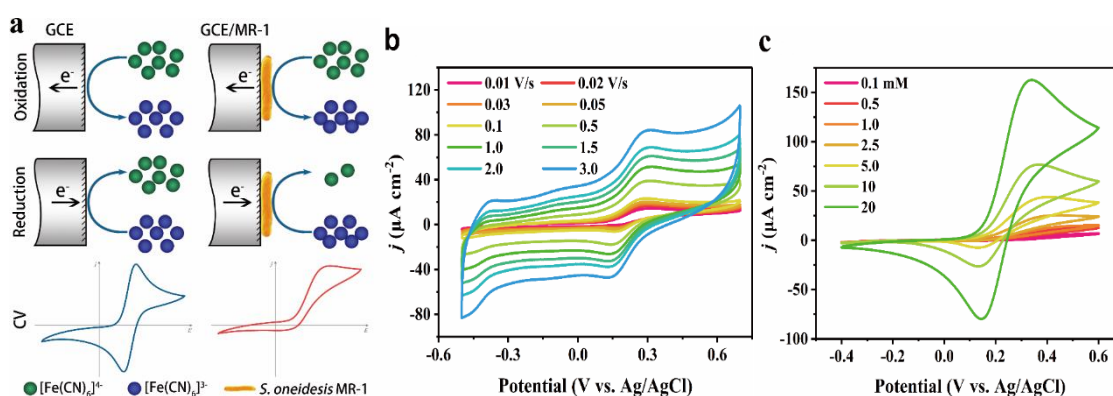


Fig. 1. (a) Reversible conversion of $[Fe(CN)_6]^{4-/3-}$ on GCE (left) and electrocatalytic oxidation of $[Fe(CN)_6]^{4-}$ to $[Fe(CN)_6]^{3-}$ by GCE/MR-1 (right). (b) Scan rate dependent CVs and (c) concentration-dependent CVs of $[Fe(CN)_6]^{4-/3-}$ conversion. The scan rate is 10 mV/s unless otherwise stated.

Acknowledgments

Supported from the China Scholarship Council (CSC) (No. [2016]3100) is appreciated.

References

- [1] C. R. Myers and K. H. Nealson, *Science*. **240**, 1319 (1988).
- [2] Y. Xiao, E. Zhang, J. Zhang, Y. Dai, Z. Yang, H. E. M. Christensen, J. Ulstrup, and F. Zhao, *Sci. Adv.* **3**, e1700623 (2017).
- [3] X. Tian, F. Zhao, L. You, X. Wu, Z. Zheng, R. Wu, Y. Jiang, and S. Sun, *Phys. Chem. Chem. Phys.* **19**, 1746 (2017).