Characterization of Single Entity Catalysis in a Nanopore Confinement

Yi-Lun Ying[†], Ru-Jia Yu, Hui Ma, Yi-Tao Long

School of Chemistry and Chemical Engineering, Nanjing University, Nanjing 210023, P. R. China.

Email: yilunying@nju.edu.cn

Abstract: The ability to directly probe catalysis of a single entity (e.g. enzyme) can potentially enable a deeper understanding of the electron transfer mechanisms that are not distinguishable in ensemble measurements. Herein, we report the direct observation of the electrocatalytic process of a single enzyme molecule in a nanopore confinement. The enzyme-catalyzed redox reactions resulting in measurable ionic current signals enable us to monitor the catalytic process of a single enzyme molecule. Using this system, we directly characterized the catalytic activity of sing enzymes in nanopore confinement and found the heterogeneities in activity between individual enzymes. This methodology may offer an alternative for studying the single-enzyme catalysis which can provide deeper insights into the fundamental understanding of enzymatic reaction dynamics and mechanisms.

References:

[1] Yu, R. J.; Ying, Y.-L.; Gao, R.; Long, Y.-T. *Angew. Chem. Int. Ed.* **2019, 58**, 3706-3714.

[2] Gao, R.; Ying, Y. L.; Li, Y. J.; Hu, Y. X.; Yu, R. J.; Lin, Y.; Long, Y. T. *Angew. Chem. Int. Ed.* **2018, 57**, 1011-1015.

[3] Gao, R.; Lin, Y.; Ying, Y.-L.; Hu, Y. X.; Xu, S. W.; Ruan, L. Q.; Yu, R. J.; Li, Y. J.; Li, H. W.; Cui, L. F.; Long, Y. T., *Nat. Protoc.* **2019, 14**, 2015-2035.

[4] Ying, Y.-L.; Hu, Y. X.; Gao, R.; Yu, R. J.; Gu, Z.; Lee, L. P.; Long, Y.-T *J. Am. Chem. Soc.* **2018, 140**, 5385-5392.

Biography:

Prof. Yi-Lun Ying studied chemistry and obtained Ph.D in Analytical Chemistry from East China University of Science and Technology (ECUST). After a doctoral exchange study in the University of Birmingham (2014), Dr. Ying carried out her postdoctoral research on nanopore single-molecule analysis and electrochemical biosensors at ECUST. Since 2016, she started her independent work on the nanopore electrochemistry at ECUST. In 2019, she was promoted to professor at Nanjing University. Prof. Ying's team is currently developing advanced electro-optical nanopores and intelligent big data analysis methods for addressing peptide/protein sequencing and uncovering the heterogeneous structure-activity relationship of the single biomolecules. She has been recognized by several awards and honors, including the L'Oreal-UNESCO International Rising Talents (2016), RSC Analyst Emerging Investigator Lectureship (2019) and Chinese Chemical Society Prize for Young Scientists (2020) .