A biomimetic membrane for the studies of electron transfer in biological system

Supported by the National Science Fund for Distinguished Young Scholars and the Major Research Plan of the National Natural Science Foundation of China, Prof. Long Yitao from the East China University of Science and Technology and his colleagues published their work entitled "Investigating electron-transfer processes using a biomimetic hybrid bilayer membrane system" in *Nature Protocols* (**2013**, 8(3): 439—450).

Redox reactions in cells play a vital role in bioenergetics, signalling, cell metabolism, and most notably photosynthesis and respiration. The underlying mechanism involves electron-transfer pathways where electrons are directionally shuttled between specific components mainly at the membrane interface. However, direct investigations of electron-transfer processes in the membrane have been challenging because of the intrinsic complexity of natural membranes and their participation in diverse cellular processes. There has, therefore, been an increasing interest in employing many different artificial model membranes in biomimetic research. As an indispensable tool for studying electron-transfer reactions, electrochemical methods have advantages in investigating the ability of biological electron-transfer reactions at interfaces and the activities of redox biomolecules. This intrigues Prof. Long and his colleagues to gain insight into investigating the electron-transfer properties by mimicking the redox reactions in a membrane-like environment. The basic technical problem faced in mimicking biological electron-transfer process is to control the flow of electrons to and from special catalytic sites. A useful strategy for achieving specific electron-transfer is to embed both redox partners capable of redox cycling (e. g., NADH and ubiquinone) in a lipid membrane system (Figure A). Based on this approach, they reported a biomimetic membrane system in which redox-active ubiquinone was embedded in hybrid bilayer membranes that contains the NADH (Figure B). The exciting finding demonstrated that reversible NADH/NAD^+ interconversion could be mediated by ubiquinone in a biomimetic membrane (*J Am Chem Soc*, **2011**, 133(32): 12366—12369). This work represents a significant step forward in understanding ubiquinone as a redox mediator and lipid bilayer membrane confinement because it allows for the reversible redox reaction of NADH and NAD^+ by mimicking the redox cycling reaction in the initial stages of mitochondrial respiration. This strategy demonstrates the power of constructing biomimetic membranes in an effort to further understand the electron-transfer processes and establishes a key platform for garnering new details from lipid membrane redox and enzymatic processes.

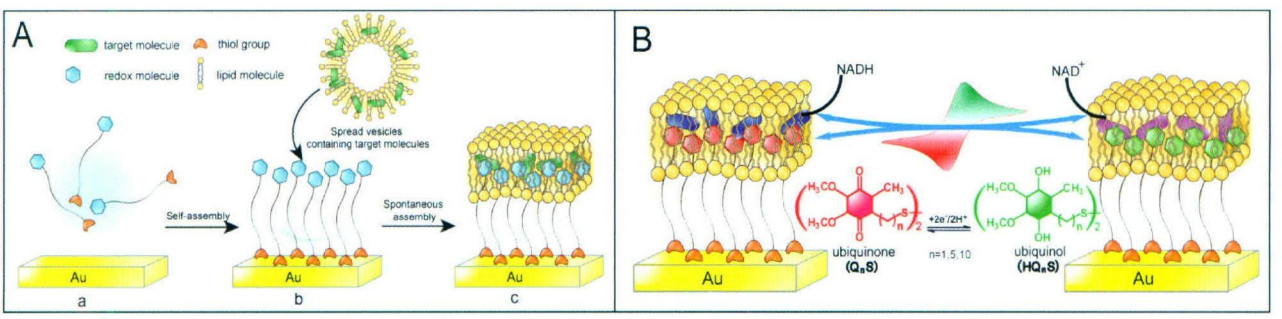

Figure **A** Biomimetic membrane strategy for electrochemical measurement. **B** Biomimetic membrane containing ubiquinones and NADH/NAD^+ redox systems.