

Molecular nature of structured water in regulation of electrostatic properties of biomebranes and subsequent interactions

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Abstract: As the most commonly used solvent molecule, the unique hydrogen bond and dipole structure of water in the electrical double layer (EDL) have an important influence on many physical, chemical and biological processes. Thus, studying the network of water in EDL is a long-time hotspot. It is not until recently that the microscopic structures of water in EDL at the interface of metal electrode/aqueous have started to be unveiled. Nevertheless, revealing the regulation of structured water in the electrostatic properties of biomembranes is still scant except the pioneer work with molecular dynamics simulations. Unfortunately, the complexed local water structure due to the adsorption of phospholipid membranes greatly challenges the molecular dynamics simulations in probing the distinctive properties of water and membrane EDL. As a result, far less is known about the local structured water and its contribution to the EDL at the electrified membrane/water interface.

Herein, based on the superiority of surface enhanced infrared absorption (SEIRA) spectroscopy combined with electrochemistry in interfacial analysis, our work clearly revealed the evolution of local water structure at the zwitterionic phospholipid membranes/aqueous interface with an external electric field. The strongly hydrogen-bonded water directly bonded to the phosphate groups has a strong mechanical strength to resist potential perturbations, whose hydrogen-bonding microenvironment has a significant effect on the broken of loosely bonded tetrahedral water and thus the conversion of optical signals into electrical signals as well as the subsequent interactions with protein. Our work has taken a first step towards insight into the relationship between water structure and the electrostatic properties at the bioelectronics interface, which is instructive in understanding important process in the electrocatalysis, energy storage and bioelectronics.

References:

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Biography:



Prof. Xiue Jiang is a professor in Changchun Institute of Applied Chemistry (CIAC) and University of Science & Technology of China (USTC). She received her Ph.D. degree from CIAC, Chinese Academy of Sciences (CAS). From 2006 to 2010, she was a Humboldt scholar and Postdoctoral Researcher at the University of Bielefeld, Germany, ULM University in Germany and the Karlsruhe Institute of Technology, Germany. Since 2010 she has been appointed a full Professor at CIAC. In 2013, She won for Excellent Young Scholars of China. In 2020, she won for Distinguished Young Scholars of China. Her current research interests mainly contain revealing the weak interactions at the interface of cellular membrane and the regulation function of water, and revealing the cellular response mechanisms at the nanoscale by various spectroscopy methods, especially surface-enhanced infrared spectroscopy, for biomedical applications. Over 80 articles have been published in SCI journal such as *Proc. Natl. Acad. Sci. USA*, *J. Am. Chem. Soc.*, *Angew. Chem. Int. Ed.*, *ACS Nano*, *Adv. Funct. Mater.* and *Anal. Chem.* and obtained 5 authorized national invention patents. All these researches were supported by 6 National Natural Science Foundation, including the National Science Fund for Distinguished Young Scholars, the National Science Foundation for Excellent Young Scientists and the Joint Sino-German Research Projects, and so on. Currently, she is an editorial board member of 《Fundamental Research》 and 《Chemical Journal of Chinese Universities》.