Atomic insights into the interfacial ion-water interaction

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Ion hydration and transport at interfaces are relevant to a wide range of applied fields and natural processes. Interfacial effects are particularly profound in confined geometries such as nanometre-sized channels, where the mechanisms of ion transport in bulk solutions may not apply. To correlate atomic structure with the transport properties of hydrated ions, both the interfacial inhomogeneity and the complex competing interactions among ions, water and surfaces require detailed molecular-level characterization. Using a noncontact atomic force microscopy (AFM) system, we were able to image the individual ion hydrates at surfaces with atomic resolution. We found that the alkali ion with specific hydration numbers diffuses orders of magnitude more quickly than other ion hydrates, arising from the degree of symmetry match between the hydrates and the surface lattice. In addition, we found that the alkali ions can come into close contact with each other through the dehydration and water rearrangement process, which is driven by the effective ionic attraction due to the interplay between the water-ion and water-water interactions. These results not only help us to understand the nature of biological ion channels, but may also provide general design principles for artificial ion channels towards high permeation rate and selectivity.

Biography

Ying Jiang is a Boya Distinguished Professor of Peking University. He received his PhD from Institute of Physics, Chinese Academy of Sciences (CAS) in 2008. After working as a Postdoctoral Associate in University of California, Irvine (2008-2010), he joined International Center for Quantum Materials, Peking

University as a tenure-track assistant professor, and was promoted to a full professor in 2018. He is the founding director of Research Center for Light-Element Advanced Materials of Peking University. Jiang serves on the Editorial Boards or Editorial Advisory Boards of Journal of Physical Chemistry, Journal of Chemical Physics, Advanced Quantum Technologies, Chemical Physics, Chinese Physics Letters, etc.

Jiang's research fields are condensed matter physics and chemical physics. His research achievement covers from the innovative development of scanning probe microscopy/spectroscopy to the pioneering application of those techniques to probe atomic-scale properties of single molecules and low-dimensional materials. He has published over 70 peer-reviewed papers, including 3 in Science, 5 in Nature, and 10+ in Nature Journals. His research works were selected twice as Top-ten Science Advances in China (2016, 2018).

Selected awards include Distinguished Young Scholars from Natural Science Foundation of China (2017), Tan Kah Kee Young Scientist Award (2018), Science and Technology Award for Chinese Youth from China Association for Science and Technology (2018), Leading Innovative Talent in Science and Technology from Central Chinese Government (2019), Fellow of American Physical Society (2019), Nishina Asia Award (2020), AAA Robert T. Poe Prize (2020).