

Insitu photoelectron spectroscopy reveals the structure of the electrical double layer

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Energy materials, such as catalysts and battery electrodes, operate through their interfaces, because interface dynamics controls mass and energy transport from liquid to solid^[1]. Therefore, characterizing these interfaces and their dynamic chemistry is crucial to tailor materials to their specific applications. Recently, interfacial spectroscopy^[2] and molecular dynamics calculations^[3] have shown that chemical and colloid interactions play a similar pivotal role at these solid-liquid interfaces at the most common electrolyte concentrations as the widely accepted models based on electrostatics. We have employed soft X-ray based interfacial spectroscopy, such as ambient pressure X-ray photoelectron spectroscopy (APXPS) and X-ray absorption total electron yield (XAS-TEY), to investigate the chemical composition and structure of aqueous electrolytes adjacent to a conductive solid phase^[4]. With a focus on the effects of cations on these solid/liquid interfaces we studied the behavior of aqueous electrolytes on hydrophobic electrodes.

We found that the interfacial water structure strongly depends on hydrophobic interactions between the electrode material and the dissolved ions. Our results suggest that these interactions can lead to the separation of hydrophilic and hydrophobic ions, triggering the reorientation of water in the formed electric fields or its displacement by adsorbed ions.

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References : [1] Björnholm, O., et al., *Chemical Reviews*, **116**(13), 2016, [2] Alfarano, S.; et al., *PNAS*, **118**(47), 2021, [3] Monteiro M. C. O., et al., *JACS*, **144**(4), 2021, [4] Felling L. J., Jaugstetter M., et al. ChemRxiv. 2024; doi:10.26434/chemrxiv-2024-r6mw7

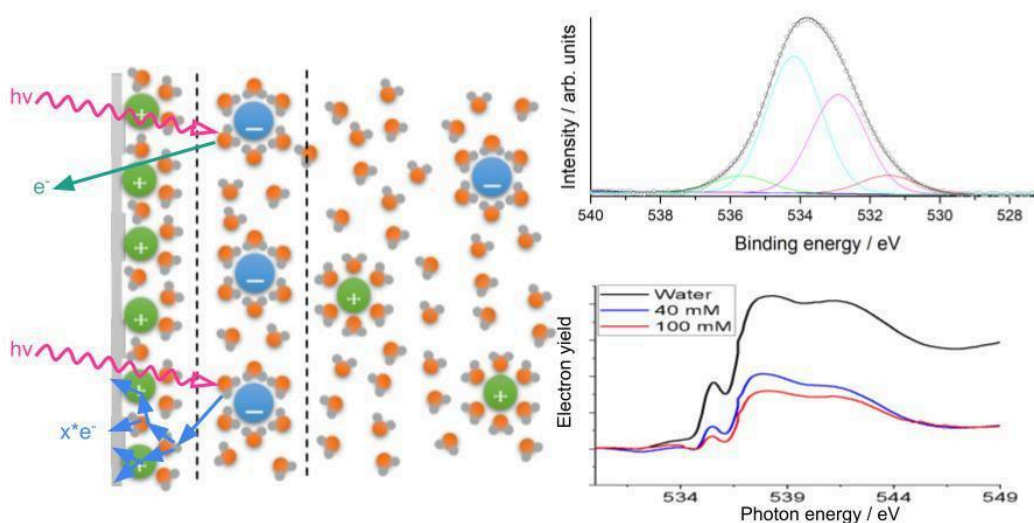


Figure 1. Soft X-ray excited photoelectrons reveal the electronic structure of interfacial water