Hydrophobic solvation at electrochemical interfaces

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Hydrophobicity locally arises in exotic ways at electrified metal-water interfaces. There, the ordering templated by strongly interacting metal surfaces on the physisorbed water adlayer induces formation of a soft water-water interface that shows "air-water-like" behaviors.[1,2]
In this presentation, I will discuss their molecular origin, and the similarities and differences to canonical hydrophobic interfaces.

Such a local hydrophobicity gives rise to interesting structural and solvation properties, which are strongly space-dependent: even a small variation of a few angstroms on the distance of the reactive species to the surface can dramatically change their solvation envoronment and chemistry, and subtle positional effects, such as the shape of the cavity formed by a solute and its orientation with respect to the surface or another reactant, which are usually negligible, can determine the energetics of chemical processes at these interface.

These emerging factors have been recently proposed to regulate a growing number of electrochemical processes at metal electrodes, as well as at some oxide-water interfaces. I will briefly show a few examples, including renewable energies,[3] acid-base chemistry,[4] electric double layer formation,[5] and heterogeneous catalysis.[6]

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[2] A. Serva, M. Salanne, M. Havenith, S. Pezzotti. PNAS 2021,118, e2023867118.
[3] N. Wichmann, W. Chen, Q. Yao, M. Bin Jassar, et al., JACS 2026, jsut accepted
[4] S. Murke, W. Chen, S. Pezzotti, M. Havenith. JACS 2024, 146, 12423.
[5] S. R. Alfarano, S. Pezzotti, C. Stein, et al. PNAS 2021, 118, e2108568118.
[6] M. Bin Jassar, Q. Yao, F. S. Brigiano, W. Chen, S. Pezzotti JPCL 15, 11961-11968 (2024)