Atomic scale dynamics and electric fields at electrocatalyst water interfaces

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Interfaces of solids to H_2O are decisive for controlling chemical reactions in heterogeneous catalysis. Despite many decades of research on Helmholtz layers and progress in theoretical modelling, the real structure and dynamics in equilibrium state as well as during electrochemical water oxidation is poorly understood.

We present in-situ high-resolution TEM and electron holography studies in H_2O vapor that give new and ground-breaking insights into the atomic structure and dynamics at catalyst surfaces including the observation of dynamic adatoms on a manganite perovskite oxide [1], the emergence of dynamic surface sheets in a layered Ca-birnessite [2], and the visualization of an ordered H_2O dipole layer at a Pt(111) surface at different applied electric potentials. These observations will help to understand coordination chemistry at solid-electrolyte interfaces during electro- and photocatalysis, to model chemical reactivity, and give insights into surface dipole fields.

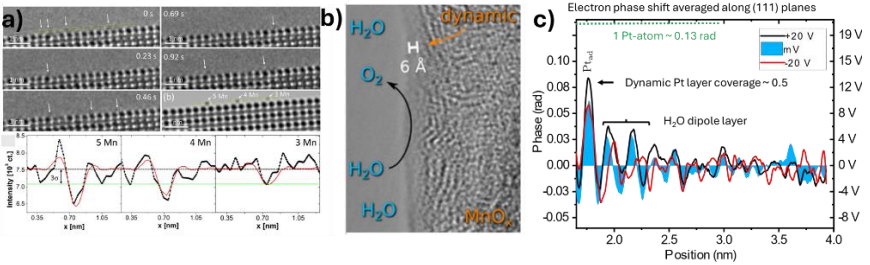

Figure 1: a) Mn adatoms on $La_{1-x}Sr_xMnO_3$ [1], b) dynamic surface layer in Ca-birnessite [2], and c) water dipoles at a Pt(111) surface studies by in-situ TEM in water vapor (unpublished).

[1] G. Lole *et al.,* Comm Mat, 2020, **1**, 68, doi.org/10.1038/s43246-020-00070-6
[2] E. Ronge *et al.,* J Phys Chem C, 2021, **125**, 5037-5047, doi.org/10.1021/acs.jpcc.0c09806