

Energetics and Chemistry at the Reactive Electrocatalyst-Liquid Interface

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Sustainable energy storage and conversion are key for the transition to a CO₂-neutral energy system. In the required transition technologies, solar energy conversion to and storage of the intermittently available electricity in chemical bonds, i.e., solar fuels (here H₂), will play a major role. To achieve the targeted scale, abundant, active, and stable converter materials and their integration into efficient devices, i.e., electrolyzers or artificial leaves, are needed. This requires an in-depth understanding of interface chemistries and energetics, especially at the reactive solid-liquid interface.

In this perspective talk, I will focus on characterization and control of interfacial properties governing the functioning of electrocatalysts and photoelectrodes. I will introduce the requirements for successful solar water splitting devices and discuss the electronic structure of the involved functional materials. At the example of CuBi₂O₄ as a promising p-type oxide photoabsorber, the experimental and theoretical characterization of interfacial energetics and chemistry will be discussed.^{1,2} Doping strategies to modulate O₂ evolution reaction activity will be presented for La_{1-x}Sr_xFeO₃³ and active phase dynamics shall be discussed at the example of the commercially relevant NiFeO_x OER anode in alkaline water electrolysis⁴. Measurement strategies to assess the chemistry and energetics at the solid-liquid interface, using synchrotron experimentation and lab-based operando spectroscopies will be introduced. The application of multi-method approaches in (photo)electrocatalysis will be discussed, also in light of new developments of synchrotron radiation experimentation.⁵

References

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