

Catalyst/Electrolyte Interfacial Transformations: Key Descriptors Governing the Oxygen Evolution Reaction at Different pHs

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The transition to a sustainable and environmentally friendly energy economy relies on efficient hydrogen production from renewable sources via electrolysis. In this context, significant efforts have recently focused on developing cost-effective and efficient electrocatalysts.

Understanding the oxygen evolution reaction (OER) mechanism on non-noble metal catalysts is of particular interest. However, the complexity of the reaction and system poses challenges in characterizing active sites and elucidating the reaction mechanism.¹ Notably, recent studies, including those from our group, have established that OER can involve lattice oxygen oxidation and extensive catalyst surface reconstruction. This was early demonstrated through operando Quick X-ray Absorption Spectroscopy (Quick-XAS) under real operating conditions and further corroborated by other key investigations.^{2,3}

Time-resolved Quick-XAS can provide dynamic snapshots of the electronic and local structure of nanocatalysts, revealing the "real active phase" of the catalyst, which may differ significantly from the as-prepared catalyst powder or the catalyst in the form of an electrode under non-operating conditions.

In this contribution, different examples will be presented to show how operando Quick-XAS, coupled with in-depth electrochemical analysis and surface characterization, can reveal the dynamic reversible/irreversible changes of OER catalysts during operation, facilitating the understanding of the key parameters governing the oxygen evolution reaction.⁴⁻⁸

Overall, the information gained from the presented studies represents a further step in the understanding of the key physicochemical properties of OER catalysts and their reaction mechanism.

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Acknowledgement:

The financial support of Swiss-Latvian Partnership in Applied Research Programme Component 2 in the areas of ICT and Smart Energy - LACISE is greatly acknowledged.