

Electrolyte Effects on the Oxygen Evolution Reaction in Neutral and Mild-Alkaline Conditions

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A key reaction in electrochemical energy production is the oxygen evolution reaction (OER). The OER plays a crucial role in the development of energy technologies such as H₂ production and CO₂ reduction (CO₂R) by acting as the counter reaction in the respective electrolyzer systems. Kinetically, the OER is a sluggish reaction characterized by a 4-electron transfer step, which results in high overpotentials, hence decreasing the overall process efficiency.¹

In recent years, the endeavor to improve the OER has largely been focused on the development of novel, more active and stable electrocatalysts. Often, the combination of high activity and stability is found with noble, scarce, and expensive materials; therefore, much of the research is nowadays focused on catalysts based on 3d-transition metals. Nevertheless, most materials still face long-term stability issues and thus a loss of catalytic activity over time. While the catalyst is key in the efficiency of the reaction, a component often overlooked is the electrolyte and furthermore, the dynamic interaction between the catalyst and the electrolyte, which can also significantly influence the electrochemical performance.^{2,3}

Based on the current relevance of the utilization of CO₂, our focus in this work is the study of the catalyst-electrolyte dynamics during OER under CO₂R conditions. Here, two critical conditions have been identified: the neutral to mild-alkaline electrolyte pH - for better CO₂ dissolution - and a relatively low electrolyte concentration - for stability and durability of membrane-electrode-assemblies. We evaluate the effect of different metal cations dissolved in the electrolyte, such as Fe and Cu, and the resulting interactions with Ni-based catalyst at different pH conditions and electrochemical protocols. The role of catalyst electrochemical conditioning on the OER activity as well as the dissolution behavior is also addressed.

In this work, the role of the electrolyte as a host for a plethora of reaction and corrosion products is highlighted.⁴ Our results show that catalyst doping occurs to different extents depending on the pH and the nature of the electrolyte, and this directly influences the OER performance. We will present results of systematic experiments on the performance of model Ni-based catalysts in neutral and mild-alkaline electrolytes, and the impact of the electrolyte nature and composition on the OER activity.

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References

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