The Road to Precious-Metal-Free Hydrogen: Challenges, Opportunities, and Mechanistic Insights

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Recent advances in the development of anion exchange membranes (AEMs) have greatly increased interest in AEM water electrolysis. This progress has stimulated intensive research into PGM-free catalysts for both the anode and the cathode, since a key advantage of AEM over PEM electrolysis is the possibility of operating without platinum group metals.

In this presentation, we will address catalyst development for both anode and cathode of an AEM electrolyser. We will discuss whether state-of-the-art PGM-free catalysts are currently capable of delivering performance comparable to the benchmark Ir-based anodes and Pt-based cathodes used in PEM electrolysers. Particular attention will be paid to the sustainability of their activity and to degradation mechanisms that may lead to the performance decay.

We will then consider the main obstacles to further improvements in activity and stability, and discuss possible strategies to overcome them. We will highlight how mechanistic insights obtained through in situ and operando methods can contribute to the rational development of improved catalysts, and how to upscale promising materials for AEM applications.

In the final part of the presentation, we will turn to the attractive concept of 'assisted' electrolysis, in which hydrogen evolution at the cathode is coupled with organic oxidation at the anode. In particular, we will focus on sugar oxidation on Ni-based anodes and discuss potentials required for these reactions, the nature of the active sites, the reaction mechanisms and products involved.

We will conclude by outlining future perspectives for AEM electrolysis.

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