ChemISTry Colloquia

Mechanism of hydrogen and oxygen electrocatalysis: beyond absorption energies.

XILE HU

EPFL

Institute of Chemical Sciences and Engineering

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Hydrogen and oxygen electrocatalysis are an essential component in many electrochemical devices such as electrolyzers, fuel cells, and air batteries. Typically absorption energies of catalyst-bound intermediates are used to understand the reactivity of catalysts. However, in reactions involving multiple intermediates, which specific absorption energies should be used? And is absorption energy alone sufficient to capture the molecular-level description of electrocatalysis? In this talk I will present our research in understanding oxygen evolution and hydrogen oxidation catalysts. I will first show how we use operando spectroscopic (Raman, IR, UV-Vis, XAS) and electrochemical methods to reveal mechanistic features of archetypical oxygen evolution catalysts such as oxides containing Ni, Co, and Fe. I will show an example of a bifunctional catalyst that involves cooperation of two metal sites that seems to overcome the so-called scaling relationship in oxygen evolution. Then I will describe our efforts in developing hydrogen oxidation catalysts in alkali media, and how the reactivity can be understood by both absorption energies as well as water structure.

Prof. Xile Hu was born in 1978 in Putian, Fujian Province, China. He received a B.S. from Peking University (2000) and a Ph.D. from the University of California, San Diego (2004; advisor: Prof. Karsten Meyer). He conducted postdoctoral research at the California Institute of Technology (advisor: Prof. Jonas Peters) before joining the faculty of the École Polytechnique Fédérale de Lausanne (EPFL) as a tenure-track assistant professor in 2007. He was promoted to associate professor in January 2013 and to full professor in June 2016. In 2023, he co-founded the startup NovaMea and serves as its chairman.

He directs an interdisciplinary research program focused on developing chemistry with potential societal impact, for example, more sustainable and efficient methods for producing bioactive compounds, non-precious electrocatalysts, and fluorine-free membranes for renewable energy conversion and storage, as well as improved electrochemical devices. His research encompasses inorganic, organic, bio, polymer, applied physical, and electrochemistry, as well as chemical engineering.