Department of Materials Science and Engineering Seminar Series 2025

Reconstruction-Derived High-Performance Electrocatalysts for the Oxygen Evolution Reaction

Zhang Qi

Date and time: 27th November 2026 (Friday), 10:00 am – 12:00 pm

Venue: EA-06-04

Abstract

Electrochemical water splitting is a promising technology for green hydrogen production and renewable electricity storage. The oxygen evolution reaction (OER), involving a complex multi-electron transfer process, remains the rate-limiting step of overall water splitting. Therefore, the development of highly active OER electrocatalysts is critical for improving the efficiency of water electrolysis. However, the reconstruction of OER electrocatalysts complicates catalyst design as it challenges the conventional structure–performance relationships. A comprehensive understanding of the reconstruction mechanisms and pathways of precatalysts is essential for the rational design and development of high-performance OER catalysts.

In this thesis, the unique hydrothermal reconstruction of SrCoO3-δ perovskite and its underlying mechanism were proposed for the first time. It was demonstrated that the highly soluble A-site cations do not completely leach into the electrolyte during reconstruction but are partially retained and intercalated into the interlayers of the reconstructed γ-CoOOH. Based on this understanding, a secondary component, Ba, was introduced into the A-site of the perovskite precatalyst to achieve programmable reconstruction. The co-intercalation of Ba and Sr cations within the reconstructed γ-CoOOH induces distortion of the CoO6 octahedra and orbital energy splitting, thereby promoting electron transfer and substantially enhancing OER catalytic performance. Furthermore, B-site doping of the perovskite precatalyst was employed to obtain a reconstruction-derived multicomponent oxyhydroxide phase, ultimately enabling outstanding OER activity and stability in anion exchange membrane water electrolyzers (AEMWEs) operated with both KOH-fed and pure-water-fed configurations. This

reconstruction strategy was extended to the transformation of layered LiTMO2 materials to enable lithium extraction.

Biography

Zhang Qi received his Bachelor's and Master's degrees from Chongqing University. He is currently a Ph.D. candidate under the supervision of Prof. Xue Jun Min and Dr. Hua Younan. His research interests focus on combining experiments and first-principles calculations to develop novel electrocatalysts for oxygen evolution reaction.

Please join us!

HOST: Asst Prof Zhong Peichen