Energie-Innovationszentrum
Cottbus

EIZ Research Seminar

»Dynamic Structural Evolution of High Entropy Alloys Under Active Oxygen Evolution and Organic Oxidation Reactions«

29th October 2025
2:00 - 3:00 pm

FZ 3E
Room 2.26/2.27

In recent years, the development of advanced electrocatalysts has become crucial for efficient electrochemical water splitting, particularly to address the sluggish kinetics of the oxygen evolution reaction (OER). High-entropy materials, composed of multiple metallic elements, offer unique opportunities for tuning active sites and exploiting synergistic effects. However, understanding their atomic-scale structure and dynamic evolution under reaction conditions remains a significant challenge. The present talk will focus on the design, synthesis, and mechanistic insights of a FeCoNiCuIr high-entropy alloy (HEA) nanocatalyst, prepared via a single-step method. Quasi in situ X-ray absorption and Raman spectroscopy provide real-time information on the oxidation state and local coordination of each metal, revealing Ir's critical role in modulating electronic structure and facilitating the oxidation of Fe, Co, Ni, and Cu. High-resolution electron microscopy shows uniform elemental distribution developing on the catalyst surface during OER. The FeCoNiCuIr HEA exhibits robust performance in anion exchange membrane water electrolysis and enables selective electrooxidation of ethylene glycol from PET waste to formate. The talk will highlight key challenges, mechanistic insights, and practical applications of HEA catalysts in green hydrogen production and sustainable plastic upcycling.

Dr. Debabrata Bagchi is currently a Postdoctoral Researcher at the Helmholtz-Zentrum Berlin für Materialien und Energie, Germany, in the framework of the project Catlab with Prof. Prashanth W. Menezes. His research focuses on the development of advanced electrocatalysts for water splitting, electrochemical CO2 conversion and organic oxidation reaction into value-added fuels and chemicals. He specializes in advanced electrochemical cell engineering, including flow-cell and gas diffusion electrode configurations, and anion exchange membrane electrolyzers. Using in-situ and operando spectroscopic techniques, he explores dynamic active sites and mechanistic pathways toward sustainable energy conversion. He earned his Ph.D. in Chemistry (2017-2022) from the Jawaharlal Nehru Centre for Advanced Scientific Research, India, and his M.Sc. from the Indian Institute of Technology Madras. He has authored over 25 publications in leading international journals including Nat. Rev. Chem., Adv. Mater., Adv. Energy Mater., Angew. Chemie., JACS and ACS Nano.

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