Electrocatalytic activities of rare earth doped Ni-Co MOFs for improved water splitting

The world is still struggling with a lack of alternative energy sources due to the rapid advancement of modern technologies. There is a great demand for sustainable and renewable energy sources because of issues with non-renewable energy sources, such as their adverse environmental effects. Due to this demand, hydrogen has proven to be an ideal energy carrier because of its high energy density, net zero carbon emissions, and eco-friendly energy. Electrochemical water splitting is the prominent approach for producing hydrogen using hydrogen evolution reaction (HER) at the cathode and oxygen evolution reaction (OER) at the anode. An electrocatalyst is crucial to break the connection between oxygen and hydrogen within water molecules. The efficiency of water splitting depends on the performance of the electrocatalyst.

Metal-organic frameworks (MOFs) are innovative materials that combine organic connectors with metallic centers. They are effective electrocatalysts due to their high degree of crystallinity, well-defined porous structure, and a large specific surface area allowing quick mass transfer and access to the active site. Previous studies have shown outstanding results using bimetal-based MOFs as electrocatalysts. However, due to their cost-effectiveness, abundance in nature, and low catalytic activity, they are rarely studied as catalysts for electrochemical water splitting. To enhance their electrocatalytic activity, rare-earth-doped bimetallic MOFs have been identified as promising strategies for improved HER and OER activities, thanks to their synergetic effect, composition diversity, and improved charge separation.

The present work aims to create a hybrid of rare earth doped Ni-Co MOF materials using the hydrothermal method and employ them as the advanced electrocatalyst for water splitting. This approach has the potential to impact sustainable energy solutions significantly. The synthesized materials will undergo thorough structural, compositional, and surface analysis using various techniques, such as X-ray Diffraction (XRD), Scanning Electron Microscopy (SEM), X-ray Photoelectron Spectroscopy (XPS), and Transmission Electron Microscopy (TEM). Furthermore, we will conduct comprehensive electrochemical studies, including cyclic Voltammetry (CV), linear sweep voltammetry (LSV), Electrochemical Impedance Spectroscopy (EIS), and chronoamperometry, to assess the materials' electrochemical properties. We believe this research's findings will significantly advance sustainable energy solutions, specifically in water-splitting electrocatalysts.