

From Frameworks to Function: MOF-Derived Materials Driving Hydrogen Evolution

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Abstract

Metal–organic frameworks (MOFs) offer tunable structures for hydrogen evolution reaction (HER) electrocatalysis but suffer from low conductivity and limited stability. This work combines two complementary strategies to link MOF structure with catalytic function. MOF material was grown in situ on nickel foam with controlled crystallinity, lattice strain, and porosity. The optimized MOF@NF delivers an overpotential of -133 mV at -10 mA cm $^{-2}$, Tafel slope of 119 mV dec $^{-1}$ with stable operation over 48 h. Spectroscopic analyses confirm its transformation into cobalt hydroxide/oxyhydroxide active species during operation. In parallel, Ni-MOF-800 derived material exhibit enhanced HER activity, achieving low overpotential 90 mV at 10 mA cm $^{-2}$, small Tafel slope

93 mV dec $^{-1}$, and improved charge-transfer properties due to increased conductivity, defect density, and electrochemically active surface area retaining the catalytic activity over 2000 cycles. These results demonstrate that catalytic performance arises from the synergy between MOF reconstruction and derived conductive structures, providing a unified strategy for designing efficient electrocatalysts for sustainable hydrogen production.

Keywords: MOFs; Electrocatalyst; HER, Energy conversion

Biography



Hassan Ait Ahsaine received his BSc in Physics, MSc in Materials Chemistry from Ibn Zohr University and a co-directed PhD degree in Materials Science from Ibn Zohr University (Morocco) and Toulon University (France) in 2016. He joined the King Abdullah University of Science and Technology (KAUST) as a Postdoctoral Researcher for 2.5 years, and then was appointed as a Researcher at Mohammed VI Polytechnic University (UM6P). He is currently an Associate Professor of Chemistry at the Mohamed V University in Rabat, Faculty of sciences. His research focuses on the development and synthesis of novel functional materials, from the nanoscale to the microscale, for environmental and catalytic applications. h.aitahsaine@um5r.ac.ma
