

Advancing OER Catalysis with Mn-Doped CoFe-LDH: A Scalable 3D Nanostructured Catalyst for Sustainable and High-Performance Energy Technologies

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Abstract : The global transition to renewable energy hinges on breakthroughs in catalysis for the oxygen evolution reaction (OER) a bottleneck in fuel cell and water-splitting technologies. The 3D nanostructured Mn-doped CoFe-LDH catalyst merges high-performance engineering with next-generation material design. By leveraging the synergistic effects of Mn doping within the CoFe-LDH framework, this self-supported catalyst achieves a quantum leap in OER efficiency. The strategically tailored 3D architecture amplifies active surface areas and facilitates seamless electron transport, while Mn incorporation fine-tunes the electronic structure, unlocking new catalytic pathways. Synthesized through an accessible hydrothermal approach, the material redefines scalability in catalyst production. The Mn-doped CoFe-LDH delivers industry-leading performance, with an impressively low overpotential of 255 mV at 20 mA cm⁻², combined with enduring stability over 24 hours of rigorous operation in alkaline media. This remarkable performance not only rivals state-of-the-art alternatives but also offers a sustainable, cost-effective solution tailored for real-world energy applications. Our findings bridge the gap between material innovation and practical implementation, setting a benchmark for OER catalysis in the era of clean energy. The Mn-doped CoFe-LDH isn't just a catalyst; it's a vision for the future of sustainable energy technologies.

Keywords : clean energy, fuel cells, layered double hydroxides (LDH), oxygen evolution reaction (OER).

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