

# Novel method for synthesis of molecular hydrogen sets benchmark for platinum-free electrocatalysts

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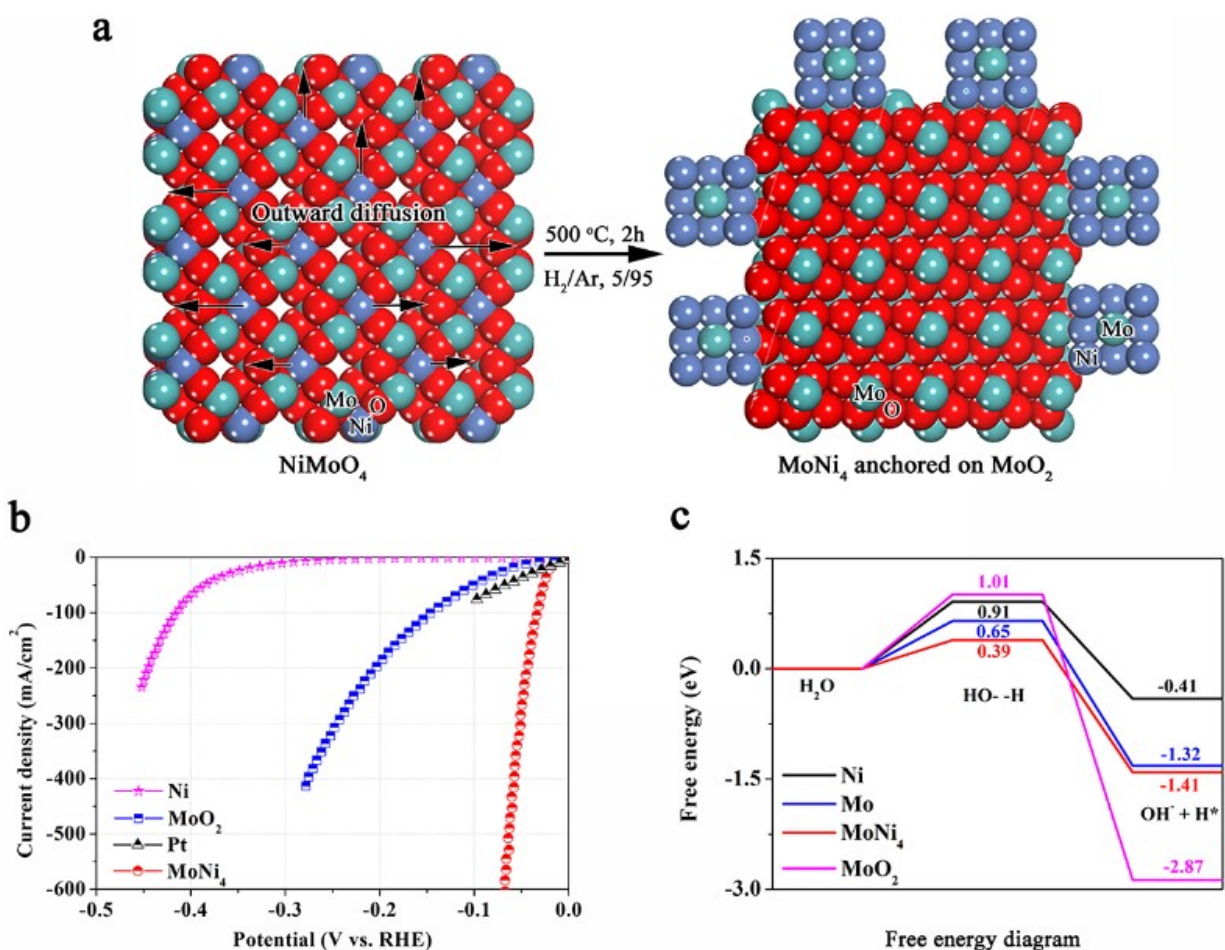


Figure. a) Synthetic scheme of MoNi<sub>4</sub> electrocatalyst supported by the MoO<sub>2</sub> cuboids on nickel foam; b) polarization curves of the MoNi<sub>4</sub> electrocatalyst supported by the MoO<sub>2</sub> cuboids, pure Ni nanosheets and MoO<sub>2</sub> cuboids on the nickel foam; c) calculated adsorption free energy diagram for the Tafel step.

Credit: Technische Universität Dresden

Growing concern about the energy crisis and the seriousness of environmental contamination urgently demand the development of renewable energy sources as feasible alternatives to diminishing fossil fuels. Owing to its high energy density and environmentally friendly characteristics, molecular hydrogen is an attractive and promising energy carrier to meet future global energy demands.

In many of the approaches for [hydrogen production](#), the electrocatalytic [hydrogen](#) evolution reaction (HER) from water splitting is the most economical and effective route for the future hydrogen economy. To accelerate the sluggish HER kinetics, particularly in alkaline electrolytes, highly active and durable electrocatalysts are essential to lower the kinetic HER overpotential. As a benchmark HER electrocatalyst with a zero HER overpotential, the precious metal platinum (Pt) plays a dominant role in present H<sub>2</sub>-production technologies, such as water-alkali electrolyzers. Unfortunately, the scarcity and high cost of Pt seriously impede its large-scale applications in electrocatalytic HERs.

Prof. Xinliang Feng's team from the Technische Universität Dresden (Germany)/ Center for Advancing Electronics Dresden (cfaed), in collaboration with the University Lyon, ENS de Lyon, Centre national de la recherche scientifique (CNRS, France), the Tohoku University (Japan) and the Fraunhofer Institute for Ceramic Technologies and Systems (IKTS) (Germany), have reported a low-cost MoNi<sub>4</sub> electrocatalyst anchored on MoO<sub>2</sub> cuboids, which are vertically aligned on nickel foam (MoNi<sub>4</sub>/MoO<sub>2</sub>@Ni).

MoNi<sub>4</sub> nanoparticles are constructed in situ on the MoO<sub>2</sub> cuboids by controlling the outward diffusion of Ni atoms. The resultant

MoNi<sub>4</sub>/MoO<sub>2</sub>@Ni exhibits a high HER activity that is highly comparable to that of the Pt catalyst and presents state-of-the-art HER activity amongst all reported Pt-free electrocatalysts. Experimental investigations reveal that the MoNi<sub>4</sub> electrocatalyst behaves as the highly active centre and manifests fast Tafel step-determined HER kinetics. Furthermore, density functional theory (DFT) calculations determine that the kinetic [energy](#) barrier of the Volmer step for the MoNi<sub>4</sub> electrocatalyst is greatly decreased. The large-scale preparation and excellent catalytic stability provide MoNi<sub>4</sub>/MoO<sub>2</sub>@Ni with a promising utilization in water-alkali electrolyzers for hydrogen production. Therefore, the exploration and understanding of the MoNi<sub>4</sub> electrocatalyst provide a promising alternative to Pt catalysts for emerging applications in energy generation.

**More information:** Jian Zhang et al. Efficient hydrogen production on MoNi<sub>4</sub> electrocatalysts with fast water dissociation kinetics, *Nature Communications* (2017). [DOI: 10.1038/NCOMMS15437](https://doi.org/10.1038/NCOMMS15437)

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