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# Three-dimensional Hierarchical MoS<sub>2</sub>/CoS<sub>2</sub> Heterostructure Arrays for Highly Efficient Electrocatalytic Hydrogen Evolution

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## Abstract

Developing non-expensive, highly active and highly stable electrocatalysts for hydrogen evolution has aroused extensive attention, owing to the necessity of novel clean and sustainable energy carriers. In this paper, we report a synthesis of free-standing three-dimensional hierarchical MoS<sub>2</sub>/CoS<sub>2</sub> heterostructure arrays through a convenient process. The investigation of electrocatalytic HER performance suggests that the MoS<sub>2</sub>/CoS<sub>2</sub> hybrid catalyst exhibits significant enhancement in HER (onset potential and potential at a current density of 100 mA cm<sup>-2</sup> are 20 mV and 125 mV, respectively) and superior durability (no shift of current density is observed after a continuous scanning of 3000 times) compared with individual CoS<sub>2</sub> and MoS<sub>2</sub>. The superior HER performance was attributed to the formation of the interface between CoS<sub>2</sub> and MoS<sub>2</sub> through the electrochemical characterization, Raman, XPS analysis, and the control experiment. The lower onset potential, higher current density, excellent durability, and the free-standing structure of the three-dimensional hierarchical MoS<sub>2</sub>/CoS<sub>2</sub> hetero-structure array make it a promising cathode catalyst suitable for widespread application.

*Keywords:* MoS<sub>2</sub>/CoS<sub>2</sub>; Heterostructure array; Free-standing; Hydrogen evolution reaction;

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