Polyhedral iron oxide supported on nickel foam as efficient electrocatalyst for overall water splitting

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Oxygen evolution reaction (OER) is a key half reaction in overall water splitting process and metal air batteries. However, this reaction is thermodynamically unfavorable and requires a large overpotential when conducted in the absence of a precious metal catalyst. Substituting these precious metal catalysts with more abundant transition metal oxide such as Fe_3O_4 is a key challenge for widespread applications of water splitting. As synthesized Fe_3O_4-nickel foam (Fe_3O_4-NF) displayed excellent catalytic activity for OER and hydrogen evolution reaction (HER). Notably, benchmark current density of 10 mA cm^{-2} was achieved at low overpotential of 251 and 187 mV for OER and HER respectively. In addition, a symmetrical water electrolyzer with FeCoO-NF as cathode and anode displayed electrical fuel efficiency of 71%. Due to in-situ transformation of the surface Fe_3O_4 to FeOOH (during OER) and Fe (0) (during HER) could be responsible for its bifunctional catalytic activity.