Bi-functional S-Doped Ni Catalysts on Copper Foams with Enhanced Electrocatalytic Performance and Excellent Stability for Electrocatalytic Water Splitting

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The low-cost and energy-efficient catalysts for water splitting are crucial for the sustainable development and renewable energy. The abundant reserves of nickel sulfides have been expected to serve as the precious metal-free materials for the oxygen evolution reaction (OER) or hydrogen evolution reaction (HER). In this research, a bi-functional S-doped Ni films on three-dimensional (3D) porous copper foams (marked as NiS_x/CF) were prepared by a one-step potentiostatic electrodeposition approach in an ethaline solution containing 40mmol NiCl₂·6H₂O and 20mmol CH₄N₂S. The phase structures, surface elemental valence state, and surface microstructures were observed by X-ray diffraction (XRD), X-ray photoelectron spectrum (XPS), and field-emission scanning electron microscope (FE-SEM). The electrocatalytic performances were measured by linear sweep voltammetry (LSV), Cyclic Voltammetry (CV), Electrochemical impedance spectra (EIS) and ISTEP Multi-Current Steps. The doping of S into Ni grains and three-dimensional porous structure were found to induce more abundant active sites, significantly improving the water splitting electrolytic activity in alkaline media. The NiS_x/CF catalyst exhibits the lowest overpotential of OER with 302mV at 20 mA·cm⁻² and the lowest overpotential of HER with 146mV at 10 mA·cm⁻². When used in electrocatalytic water splitting, it displays a low cell voltage usage of 1.532V at 20mA cm⁻² in 1 M KOH. Furthermore, it maintained excellent stability under multiple potentials. Therefore, this research offers a simple synthesis route to fabricate precious metal-free OER and HER Bi-functional catalysts for electrocatalytic water splitting.

Keyword: S-doped Ni; copper foam; catalyst; electrocatalytic activity; electrocatalytic water splitting

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