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Dealloying- Derived Porous Self-Supported Nicu Electrode with Hollow Dendrite Structure for Hydrogen Evolution Reaction

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Abstract

The development of cost-effective electrocatalysts for hydrogen evolution reactions (HER) is crucial for sustainable hydrogen production, yet hindered by sluggish kinetics in alkaline media. In this work, electrochemical deposition technology was adopted to achieve the ordered structure and growth of NiCu through the hydrogen bubble template method. The initially prepared binary NiCu coating was further treatment using dealloying processes to design and synthesize a self-supporting electrode (D-NiCu) with a three-dimensional (3D) hierarchical hollow structure. Combining the advantages of micro-nano hierarchical porous structure and bimetallic active catalytic sites, the self-supporting D-NiCu electrode improved significantly enhanced alkaline HER performance. Compared with the NiCu-3 catalyst (141.3 mV at 10 mA cm^{-2} and

116.5 mV dec^{-1}), D-NiCu-3 catalyst demonstrated an overpotential of 54.9 mV and the Tafel slope of 43.6 mV dec^{-1} in 1 M KOH. Through component regulation and structural optimization, this work reveals the influence mechanism of different pore structures on ion and molecule transfer in electrochemical reactions, providing an expandable strategy for the optimization design of high-performance electrodes through pore structure-mediated reaction kinetics.

Keywords:

Nicu, Porous, Self-Supported Electrocatalyst, Electrochemical Impedance Spectroscopy, Distribution of Relaxation Times, Hydrogen Evolution Reaction