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CeO_2-Decorated Graphene-coated Nickel Foam with NiCo Layered Double Hydroxide for Efficient Hydrogen Evolution Reaction

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Abstract : Under the dual pressure of the global energy crisis and environmental pollution, avoiding the consumption of non-renewable fossil fuels based on carbon as the energy carrier and developing and utilizing non-carbon energy carriers are the basic requirements for the future new energy economy. Electrocatalyst for water splitting plays an important role in building sustainable and environmentally friendly energy conversion. The oxygen evolution reaction (OER) is essentially limited by the slow kinetics of multi-step proton-electron transfer, which limits the efficiency and cost of water splitting. In this work, CeO_2@NiCo-NRGO/NF hybrid materials were prepared using nickel foam (NF) and nitrogen-doped reduced graphene oxide (NRGO) as conductive substrates by multi-step hydrothermal method and were used as highly efficient catalysts for OER. The well-connected nanosheet array forms a three-dimensional (3D) network on the substrate, providing a large electrochemical surface area with abundant catalytic active sites. The doping of CeO_2 in NiCo-NRGO/NF electrocatalysts promotes the dispersion of substances and its synergistic effect in promoting the activation of reactants, which is crucial for improving its catalytic performance against OER. The results indicate that CeO_2@NiCo-NRGO/NF only requires a lower overpotential of 250 mV to drive the current density of 10 mA cm-2 for an OER reaction of 1 M KOH, and exhibits excellent stability at this current density for more than 10 hours. The double layer capacitance (Cdl) values show that CeO_2@NiCo-NRGO/NF significantly affects the interfacial conductivity and electrochemically active surface area. The hybrid structure could promote the catalytic performance of oxygen evolution reaction, such as low initial potential, high electrical activity, and excellent long-term durability. The strategy for improving the catalytic activity of NiCo-LDH can be used to develop a variety of other electrocatalysts for water splitting.

Keywords : CeO_2, reduced graphene oxide, NiCo-layered double hydroxide, oxygen evolution reaction
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