Flexible Electrocatalysts for Hydrogen and Oxygen Evolution

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Electrolysis of water is one of low-cost green hydrogen production technologies. The challenge is designing and developing low-cost and high-activity catalysts. Herein, we present a strategy to fabricate flexible electrocatalysts based on nickel-iron (NiFe) alloy coatings. NiFe coatings were plated on the flexible copper-coated polyimide surface (Cu/PI) using the low-cost and straightforward electroless metal plating method and morpholine borane as a reducing agent. The plating solution consisted of 0.14 M nickel sulfate, 0.05 M ethylenediaminetetraacetic acid, 0.1 M sodium malonate, 0.2 M glycine, 0.2 M morpholine borane, and 0.5-10 mM iron sulfate has been used for the NiFe coatings deposition on Cu/PI. The plating bath operated at a temperature of 60 °C for one hour. Morphology, structure, and composition of NiFe/Cu/PI catalysts have been examined using scanning electron microscopy (SEM), energy dispersive X-ray spectroscopy (EDX), X-ray diffraction (XRD), X-ray photoelectron spectroscopy (XPS), and inductively coupled plasma optical emission spectroscopy (ICP-OES), whereas their activity has been investigated for hydrogen evolution (HER) and oxygen evolution (OER) reactions in 1 M KOH using linear sweep voltammetry (LSVs) and chrono-techniques. It was found that $Ni_{90}Fe_{10}$, $Ni_{80}Fe_{20}$, $Ni_{60}Fe_{40}$, and $Ni_{30}Fe_{70}$ coatings were deposited on the Cu/PI surface, then the concentration of Fe^{2+} in the plating solution was 0.5 mM, 1 mM, 5 mM, and 10 mM, respectively. The data on the HER and OER on the NiFe/Cu/PI catalysts in an alkaline medium are compared and discussed based on electrochemical data.

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