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Improving the Electrocatalytic Activity for Hydrogen Evolution Reaction by Lowering the Electrochemical Impedance of RuO_2/Ni-P

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Abstract: In this paper Ni-P, RuO_2 and RuO_2/Ni-P composites were deposited on Ni plates through pulsed electrodeposition method, and their activities for HER in alkaline solution were studied comparatively. Scanning electron microscope (SEM), energy dispersive X-ray spectroscopy (EDS) and X-ray photoelectron spectroscopy (XPS) analysis confirmed the formation of every composite. The electrochemical impedance spectroscopy (EIS) showed that Ni-P/Ni had lower charge transfer resistance at high overpotential and higher charge transfer resistance at low overpotential than RuO_2/Ni. While Ni-P/Ni exhibited lower catalytic activity for HER at low overpotential and higher catalytic activity at high overpotential than RuO_2/Ni. Meanwhile, RuO_2/Ni-P/Ni had the lowest charge transfer resistance and highest catalytic activity among the three electrodes at both low and high overpotentials. It indicated that RuO_2/Ni-P/Ni with less Ni-P and RuO_2 exhibited enhanced catalytic activity for HER than both RuO_2/Ni and Ni-P/Ni, due to an electron charge transfer synergistic effect of RuO_2 and Ni-P.

Key words: Hydrogen evolution, Alkaline, Electrodeposition, RuO_2/Ni-P/Ni

1. Introduction

Improvement in the efficiency and durability of the low cost electrocatalyst for hydrogen evolution reaction (HER) is a fundamental goal in electrolysis of water. Hydrogen is an alternative fuel for fossil-fuel-based technologies. Today, the renewable hydrogen is mainly produced electrocatalytically from the water-alkali electrolysers and chlor-alkali industry [1, 2]. Hydrogen evolution reaction (HER) is effectively facilitated by noble metals which generate large cathodic current densities at low overpotential [3-7]. While the scarcity and high cost of the noble metals prohibits their wide-scale applications. So the replacement of noble metals with cost effective but highly efficient alternatives is desirable to achieve large-scale hydrogen