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Evaluation of the Electrocatalytic Activity of Nickel-Molybdenum Nanoparticles for Hydrogen Production

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ABSTRACT

Nickel -molybdenum nanoparticles as electrocatalyst for hydrogen reaction evolution (HER) were electrodeposited on glassy carbon and carbon felt electrodes under short constant current density pulses. Their electrocatalytic activity was determined analyzing the Tafel parameters obtained from experiments of cathodic polarization in diluted sulfuric acid. The catalytic activity of the nickel-molybdenum deposits were evaluated by comparing their Tafel parameters with those obtained for platinum nanoparticles prepared in this work following a similar methodology as for the NiMo deposits. Additionally, the corrosion stability against of the nanoparticles of nickel-molybdenum as a function of molybdenum was measured by cyclic voltammetry. It was observed that the concentration of molybdenum in the electrolytic bath affects the electrocatalytic efficiency of nanoparticles, since at higher concentrations higher currents for hydrogen evolution are observed reaching 100 mAcm $^{-2}$ at −0.75V vs. SCE . It was also concluded that as the molybdate concentration in the electrolytic bath was increased, the oxidation potential of the deposit is increasingly positive, indicating that a greater stability was conferred. The total charge under the anodic process corresponding to the oxidation of the deposit observed in cyclic voltammetry is proportional to the current pulse applied during its electrodeposition. In the experiments of electrodeposition on carbon felt, multiple pulses of current of 170 and 250 mA cm^{-2} were applied for the synthesis of the nanoparticles. Comparison of the electrocatalytic activities of Ni-Mo and Pt deposits demonstrate that similar values can be obtained varying the particle density of the deposits.

Keywords: HER, Nickel-Molybdenum, nanoparticles