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Evaluation of nickel-molybdenum-oxides as cathodes for hydrogen evolution by water electrolysis in acidic, alkaline, and neutral media

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Abstract

Hydrogen produced by electrolysis employing wind/hydro/solar electricity has been identified as a promising renewable and environmentally-friendly energy carrier. The current paper is a study on the investigation of electrocatalytic properties of Ni-Mo-oxides in the hydrogen evolution reaction (HER) by water electrolysis in the acidic, alkaline, and neutral electrolytes. The Ni-Mo-oxides of several compositions were formed on a titanium substrate employing a thermal-decomposition method. The morphology of the obtained coatings was investigated by scanning electron microscopy, and their crystallinity by X-ray diffraction. Linear Tafel polarization and chronoamperometry were used to determine the extrinsic and intrinsic electrocatalytic activity of the coatings (cathodes) in the HER. The most extrinsically active coating was found to be $Ni_{0.6}Mo_{0.8}$-oxide (in all three electrolytes), while this coating showed the highest intrinsic activity only in the neutral electrolyte. In the acidic and alkaline electrolyte, the $Ni_{0.8}Mo_{0.2}$-oxide coating was found to be most intrinsically active. In the alkaline electrolyte, the $Ni_{0.8}Mo_{0.2}$-oxide cathode had twice the intrinsic electrocatalytic activity of the current state-of-the-art, pure nickel.

Keywords: Hydrogen; Water electrolysis; Cathode; Molybdenum; Nickel; Metal oxides.

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