Corrosion behaviour of nickel and nickel alloy coatings on stainless steel in highly alkaline environments: effects of chloride and bromide

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Alkaline water electrolysis is a mature technology for production of renewable hydrogen. However, projected demands for clean hydrogen will be hard to achieve without consideration of direct seawater electrolysis, because its abundance and availability. Because of its maturity, alkaline water electrolysis represents a convenient basis for the improvements and adjustments for direct seawater electrolysis, which include design of active and corrosion-resistant materials, with improved selectivity. If this is to be achieved, it is important to identify the seawater components that significantly contribute to the corrosion, quantify their contribution, and understand mechanism of their detrimental behaviour, which leads to the loss of activity and selectivity. This study explores the corrosion behaviour and stability of nickel-based coatings for the hydrogen evolution reaction in alkaline media. Nickel strike and nickel-molybdenum coatings on stainless-steel mesh were obtained by constant current electrodeposition at different deposition times. Electrochemical characterization was conducted using linear and cyclic voltammetry, Tafel analysis, and electrochemical impedance spectroscopy. Tests were performed in 1 M KOH solution, 1 M KOH solution with chloride ions (0.5 M), and 1 M KOH solution chloride (0.5 M) and bromide (5 mM) ions. Corrosion behaviour is significantly altered by both anions and is generally decreased in the order KOH -> KOH+Cl^- -> KOH+Cl^- +Br^- for all samples, which is important to notice not only because of the loss of electrocatalytic activity, but also because of the detrimental effects on the steel support.

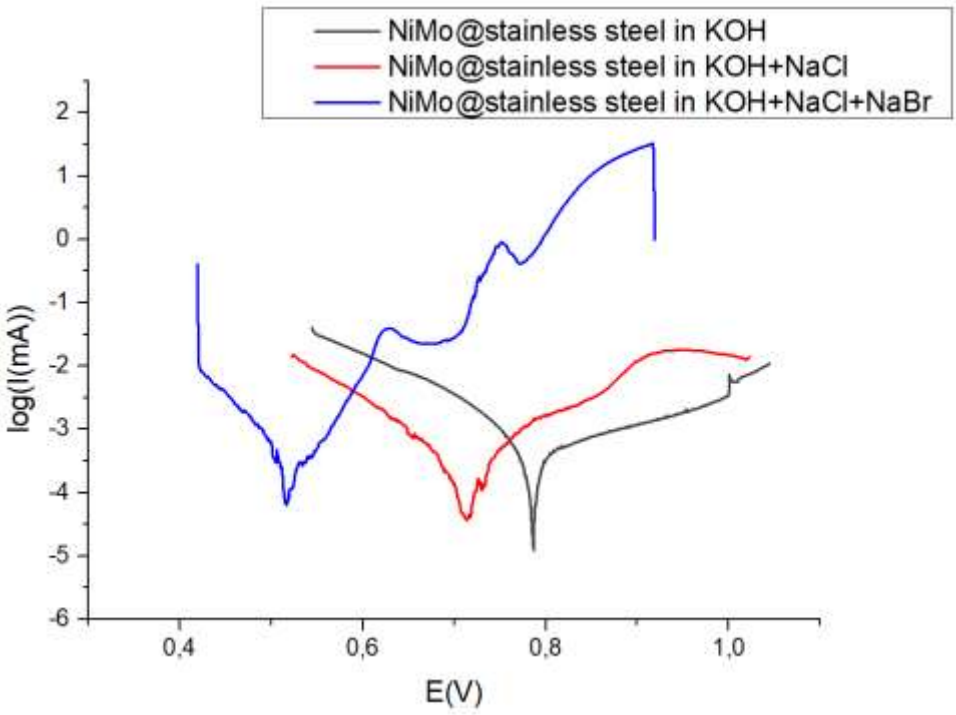

Figure 1. Tafel plots of NiMo alloy on stainless steel in various electrolytes

Reference:

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