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Nickel-rare earth electrodes for hydrogen evolution in alkaline water electrolysis

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The direct electrochemical splitting of water is a promising method for large-scale hydrogen production. Novel electrocatalytic materials for the hydrogen electrode are being actively investigated to improve the energy efficiency of current alkaline electrolyzers.

Noble metal alloys, including platinum (Pt), are known to possess good catalytic activity towards the hydrogen evolution reaction (HER). However, their high price and shortage in global supply prevents them to be considered for practical applications.

Nickel and its alloys are relatively low-cost materials and have been shown to present good electrocatalytic activity for H_2 evolution, making these Ni-based electrodes the most usual choice for industrial applications in alkaline media [1].

Very recently it has been shown that by using rare earth (RE) materials alloyed with Pt, a significant improvement of the catalytic activity of the electrode was observed, in comparison with a single Pt electrode [2,3].

Therefore, to verify if rare earth materials could also enhance the electrocatalytic activity of Ni, for the present paper we have prepared and tested several Ni-RE alloys, e.g., Ni-samarium (Sm), Ni-cerium (Ce), Ni-dysprosium (Dy), with different amounts of rare-earth material, ranging from 5 to 10 at.%.

The electrodes are tested in 8 M KOH aqueous electrolytes at temperatures ranging from 25 to 85 ºC. Polarization measurements are done to evaluate the HER on the Ni-RE alloy electrodes and allow the determination of several kinetic parameters, namely the Tafel coefficients, charge-transfer coefficients, and exchange current densities, allowing for a direct comparison of the intrinsic HER activity of these electrodes with single Ni metal electrode prepared according to the same procedure.

References

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