Ni-Cu electrodes for hydrogen evolution reaction

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Alkaline electrolysis of water is an excellent method of obtaining an environmenttally friendly energy carrier as hydrogen. It is possible to use not noble metals such as Ni and its alloys with Cd, Bi, Cu as the catalysts for electrolysis [1]. Nickel alloys are obtained electrochemically with the formation of powders or loosely packed coatings at current densities close to the diffusion limit [1, 2]. The purpose of this work was to obtain powders of Ni and Ni-Cu alloys by Ni(II) and Cu(II) reduction with hydrazine hydrate in aqueous media and to analyze the possibility of their using as the catalysts in the process of alkaline electrolysis of water. Powder Ni-Cu alloys with Ni content of 93.0 and 55.0 at.% (solid Cu solution in Ni) have been synthesized. The morphology study of the Ni-Cu powders showed that regardless of composition they consist of small spherical grains 0.2–0.3 μm in sizes and loose aggregates (2–10 μm), Fig. a. The catalytic activity of the powders was assessed by cyclic voltammetry (CV) in 0.1 M KOH in three-electrode cell including working electrodes prepared from powders pressed into tablets with surface area of 1 cm^2, Pt pseudocomparative and indicator electrodes. It was revealed that the catalytic ability of the powders in the alkaline medium decreases in the order of Ni > Ni 93.0 – Cu > Ni 55.0 – Cu, Fig. b. Catalysts stability during cyclic using decreases in the row of Ni 55.0 – Cu > Ni 93.0 – Cu > Ni, Fig. c.

Based on the results of the work performed, it can be concluded that the Ni 95.0 – Cu alloy is the most applicable in alkaline catalysis, since its catalytic activity is close to that for nickel, but it is more resistant to oxidation during cyclic operation.

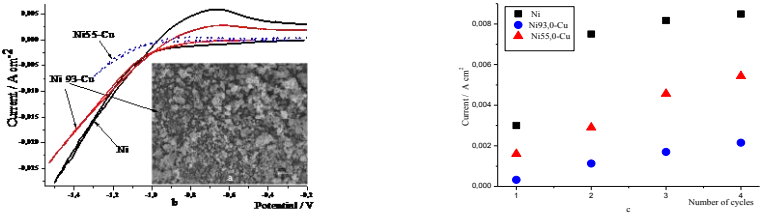

Fig. CV curves for working electrodes from nickel and its alloy powders in 0,1 M KOH (a), SEM photo of Ni 93.0 – Cu powder (b); the dependence of the current in the maximum of the anodic peak characterizing nickel oxidation from the number of cycles (c)

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References

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