Nickel–tin alloy as the catalyst in the electrochemical process of alkaline hydrogen evolution

O.N. Vrublevskaya, T.N. Vorobyova, M.G. Galuza, A.A. Kudaka, A.V. Kobets
Research Institute for Physical Chemical Problems, Belarusian State University,
Minsk, Belarus, e-mail: *haluzamg@gmail.com*

Hydrogen (H_2) is the most promising alternative energy source for the future. The alkaline water electrolysis is widely used for the production of H_2 and nickel is one of the most suitable metals for its electrocatalytic evolution. It is known [1, 2] that the electrocatalytic ability of nickel increases in case of usage instead of nickel its alloys with Se, P, Mn, Ti.

The purpose of this work was to analyze the possibility to use Ni–Sn alloy as the catalyst in the process of hydrogen evolution in 0.1 M KOH solution. Ni–Sn powder alloy with 72,2±5,8 at.% of nickel was synthesized electrochemically, its phase composition includes crystalline phases of Ni, β-Sn and NiSn, Ni_3Sn, Ni_3Sn_2, Ni_3Sn_4, powder surface area is 1,00±0,01 $m^2 \cdot g^{-1}$ (determined by the BET method). CV investigations were conducted in three-electrode cell with Pt counter and reference electrodes. Working electrode was prepared by applying Ni-Sn suspension (mixture of 4 vol.% nafion, 20 vol.% isopropanol, 76 vol.% deionized water, 46 mg of Ni–Sn powder). To compare the catalytic activity, Sn and Ni-P powders were used and CV curves were recorded (Fig.). It was found that synthesized Ni–Sn alloy, in comparison with Ni–P and Sn powders provides the highest value of the current density and the lowest value of hydrogen evolution potential. The electrochemically active surface area of nickel, calculated according to [2], for Ni–Sn powder is two times higher than that for Ni–P powder and equals to 66 $cm^2\ mg^{-1}$. Thus it is shown that Ni–Sn powder is more catalytically active than Ni–P and Sn in the electrochemical hydrogen evolution.

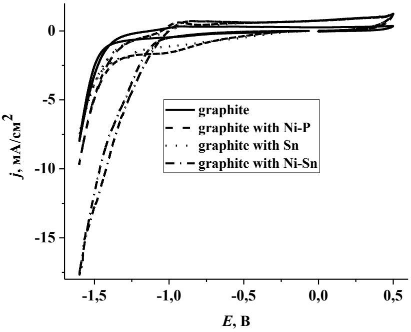

Fig. CV curves in 0,1 M KOH with a scan rate 10 $mV \cdot s^{-1}$

Acknowledgment.
This work was supported by the BRFFR grant №X20MH-004.

References

[1] B.M. Jović et al. Elect. Acta (2013) 114:813

[2] A.G. Oshchepkov. Study of hydrogen electrode reactions on nickel electrocatalysts in an alkaline medium. Ph.D. thesis. (2017). (in rus)