

ELECTROCATALYTIC VANADIUM-CONTAINING MATERIALS FOR THE HYDROGEN ENERGY**Sakhnenko M.D., Zhelavska Yu.A., Zyubanova S.I., Horokhivska N.V.***National Technical University**"Kharkiv Polytechnic Institute", Kharkiv*

The study of existing energy-saving materials and obtaining the new ones for reducing the cost of the hydrogen production, is relevant for modern hydrogen energy industry. Such properties can be predicted for materials containing vanadium, molybdenum, tungsten and exhibiting catalytic activity for the hydrogen evolution reaction.

The induced co-deposition of nickel with vanadium and cobalt with vanadium from the electrolyte solutions was investigated in the current work. As a result of the research, it was found that the uniform microcrystalline light-gray high-quality nickel-vanadium and cobalt-vanadium alloy coatings are possible to precipitate from electrolyte (Table 1).

Table 1 – Electrolytes and modes of coatings electrodeposition

Electrode material	Electrolyte	Vanadium content (in terms of metal), g/dm ³	j, A/dm ²	t, °C	pH	Vanadium content in the coating, %
St.20 with Ni-V coating	sulfate	0,1–0,3	2–5	40–50	4,5–5,5	0,2–0,45
St.20 with Co-V coating	citrate	20	5–10	30–40	2,8–3,2	0,37–0,53

The catalytic activity study of the coating that was obtained using cobalt-vanadium and nickel-vanadium alloys in the reaction of hydrogen reduction at the cathode was performed in solution of 2,5M NaOH + 0,02 M NaCl. It was found that the overvoltage of the hydrogen ion evolution reaction on cathodes from steel 20 with cobalt-vanadium or nickel-vanadium coatings is 0.05–0,1 V lower, and the exchange current is higher than on electrodes made of steel 20, which are used in industrial water-alkali electrolysis (Table 2).

Table 2 – Kinetic parameters of the HER on the cathodes made of investigated materials

Electrode material		a, V	b, V	$-\lg j_0$, A/cm ²	$\Delta E_{0,01}$, V	$\Delta E_{0,05}$, V
St.20		–0,64	–0,148	4,90	–0,38	–0,46
St.20 with Co-V coating (V,%)	0,53	–0,54	–0,160	3,36	–0,22	–0,26
St.20 with Ni-V coating (V,%)	0,45	–0,59	–0,140	4,20	–0,30	–0,40

This indicates the electrocatalytic activity of the investigated materials for the hydrogen evolution reaction. Electrodes with coating, obtained by cobalt-vanadium or nickel-vanadium alloys can be recommended as a cathode materials for the hydrogen electrochemical production. Hydrogen evolution overvoltage reduction also decrease the energy consumption for this process by 15 – 20 %.