EFFECT OF VANADIUM CONTENT IN COATINGS ON THEIR CATALYTIC ACTIVITY IN THE HYDROGEN EVOLUTION REACTION

Sakhnenko M., *Zhelavska Yu.*, Proskurina V., Korohodska A.
National Technical University "Kharkiv Polytechnic Institute", Kharkiv, Ukraine
juliazhelavska@gmail.com

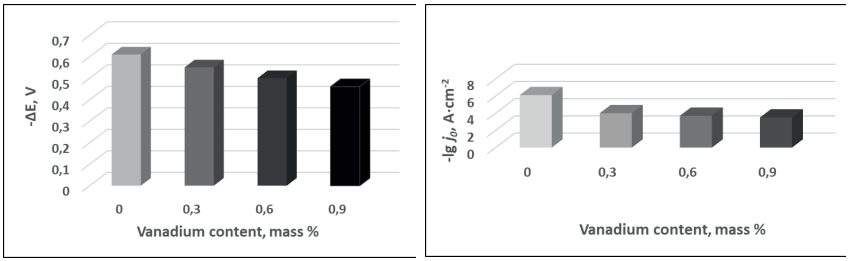
Electrochemical hydrogen production involves using cathode materials that have catalytic properties for the hydrogen evolution reaction (HER). Such materials reduce energy consumption for this process and the cost of produced hydrogen.

Analysis based on the literature data allows us to predict the catalytic activity of the HER for materials containing vanadium.

The studied coatings with the cobalt-vanadium alloy were electrodeposited from the complex citrate electrolyte with a content of 0,1 mol·dm^{-3} vanadium (in terms of metal) via pulse electrolysis modes. The process was carried out at a current density of 5–7 A·dm^{-2} with a different ratio of pulse time to pause time, at a temperature range of 35–40°C and pH = 3,0–3,5. Electrolysis in pulse mode was performed using a pulse potentiostat PI-50-1.1 with a PR-8 programmer. Polarization dependences of hydrogen evolution on cathode were obtained using MTech PGP-550M potentiostat.

The results of the X-ray dispersive spectrometry show that the vanadium content in the Co-V coating is 0,2–1,0 mass %.

The catalytic activity study of the obtained cobalt-vanadium alloy coating towards the hydrogen evolution reaction at the cathode was performed in a solution of 2,5M NaOH. Analysis of the polarization dependences, interpreted in the Tafel coordinates, made it possible to determine the kinetic parameters of the HER for the electrodes studied. (Fig.1 a, b).



a b

Fig. 1. Dependence overvoltage of the HER (a) and exchange current density (b) on vanadium content

The overvoltage (ΔE) of hydrogen reduction on electrodes with cobalt-vanadium coating is on average less by 0,2 V and the value of the exchange current density (j_0) for such electrodes is greater which indicates a higher electrocatalytic activity of these materials in comparison to electrodes with Co coating. With increasing vanadium content in the coating, the overvoltage value decreases and the exchange current density increases accordingly (Fig. 1 a, b). Electrodes with Co-V coating can be recommended as a cathode material for electrochemical hydrogen production.