TERNARY COBALT BASED ELECTROLYTIC ALLOYS AS CATALYTIC MATERIALS FOR METHANOL OXIDIZING

M.V. Ved', Dr.Sc., Prof., N.D. Sakhnenko, Dr.Sc., Prof., T.A. Nenastina, Ph.D, S.I. Zyubanova

National Technical University «Kharkiv Polytechnic Institute», 61002, Kharkiv, Kyrpychova str. 2,

nenastina@ukr.net

Eco-friendly fuel cells (FC), solar cells (SC) are among the promising renewable energy sources, however, the high cost of the noble metal electrodes prevents their dissemination and widespread use. Development of FC, SC and various red-ox flow batteries (RFB) needs to create effective catalytic electrodes based on the transition metals. Even brief review gives an impression that in scientific literature for the last years there are too few publications on electrode materials on the basis of hi-tech materials, such as nanostructured and nanocrystalline materials based on the corrosion resistant amorphous metal alloys (metal glass), or nanostructured deposits by synergistic alloys [1]. The most efficient directions of catalytic materials synthesis are electrochemical technologies that provide flexibly control the composition, the deposition rate, the state of the surface, by varying the electrolyte nature and polarization mode. Because of this it is possible to fabricate the deposits with desirable functional properties (synergistic or additive).

Alloys Co-Mo-W(Zr) were deposited onto the steel substrate from a citrate-diphosphate bath in pulse mode [2]. The chemical composition of the coatings, surface morphology and structure of the deposits was examined. Electro catalytic properties of coatings were studied in model reaction of methanol electrooxidizing in alkali medium using cyclic voltammetry (CVA) technique.

Structure of the ternary alloys was found to be amorphous-crystalline, and coherent-scattering region size was of 2−8 nm. Co-Mo-W coatings contain intermetallic phases Co_7W_6, and Co_7Mo_3, and Co_3Mo and Co_7Mo_6 ones are found in the structure of Co-Mo-Zr deposits. Analysis CVA obtained at the Co-Mo-Zr coated electrode polarization in methanol containing alkaline solution shows the activity of electrodes in the oxidation of methanol is significantly higher than that of platinum, and for the Co-Mo-Zr alloy, the peak height is 2–2.5 times than for Co-Mo-W. The increased catalytic activity of the coatings is due to both a high degree of surface development and the synergistic effect of alloying metals. The results obtained indicate a rather high electrocatalytic activity of Co-Mo-Zr deposits, and it can be concluded that the $(CH_3OH)_S \rightarrow (HCHO)_S$ reaction is the slow stage of net process, which allows for cycling latter and prevents the formation of carbon dioxide.

References

1. Karakurkchi A.V., Ved' M.V., Sakhnenko N.D. et al. Functional properties of multicomponent galvanic alloys of iron with molybdenum and tungsten // Functional Materials, 2015.-22.-P.181-187