

MECHANICAL PROPERTIES OF GALVANIC METALOXIDE Fe-Co-MoO_x COATING

Tur Yu. I., Sakhnenko M. D., Ved` M. V., Yermolenko I. Yu., Karakurkchi G. V.

National Technical University “Kharkiv Polytechnic Institute”,

Kharkiv, Ukraine

organick@ukr.net

The paper discusses the results of testing the mechanical properties of metal oxide galvanic Fe-Co-MoO_x coatings deposited onto a mild steel from a complex citrate bath contain, g/dm³: Na₃C₆H₅O₇ × 2H₂O – 95–100; Fe₂(SO₄)₃ × 9H₂O – 30–45; Na₂MoO₄ × 2H₂O – 15–25; CoSO₄ × 7H₂O – 30–45; Na₂SO₄ – 15–45; H₃BO₃–6. Electrolysis was carried out in a galvanostatic mode at a current density $i = 2.5\text{--}3$ A/dm².

Elemental composition and morphology of coatings were determined by energy dispersive X-ray spectroscopy. Surface roughness was determined as the arithmetic mean of R_a in accordance with international standards ISO 4287/1 according to the results of research by atomic force microscopy. Thermal stability was tested by heating the samples from 25 to 800 degrees in air. The microhardness of the coatings and the substrate material (mild steel) was determined by the Vickers method on a PMT-3 hardness tester at loads $P = 0.02\text{--}0.2$ kg and a holding time of 10 s.

The deposited coatings are characterized by a high oxygen content both on the hills (21 Fe, 22 Co, 26 Mo, and 31 O at.%) and in the valleys (16 Fe, 17 Co, 20 Mo and 47 O at.%), which is confirmed by the data SEM analysis and indicates the inclusion of molybdenum oxides MoO_x in the alloy structure. This makes it possible to consider Fe-Co-MoO_x coatings as composite materials. The obtained coatings demonstrate high adhesion to the substrate material and retain it under mechanical loads, such as polishing, fracture at an angle of 90°, preparation of cross-sections, etc., which is confirmed by the results of metallographic studies. The results of atomic force microscopy studies indicate the formation of a globular structure of the coating surface with spheroid sizes of 2–3 μm. The surface roughness R_a is defined as 0.15, which allows us to relate the obtained materials to the 9–10 class of roughness. Heating samples with Fe-Co-MoO_x coating to 800 °C in air showed that the coatings are thermally stable in the temperature range from 25 to 600 degrees (Fig. 1). The formation of scale is observed on the surface of the samples and an increase in the mass of the samples at an increase in the annealing temperature to 700 degrees (Fig. 1f).

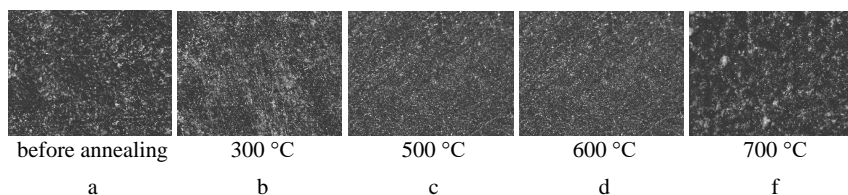


Fig. 1. Images of the samples with Fe-Co-MoO_x coating before (a) and after (b-f) heat treatment. The thickness of the coatings is 20 μm. Magnification ×40

The microhardness of samples with ternary coating is 595–630 kgf/mm², which is 2.5–3.5 times higher than those of the substrate material and 1.5 times higher than the microhardness of binary coatings.

Thus, high indicators of microhardness and thermal strength of composite coatings of the Fe-Co-MoO_x system make it possible to consider these coatings as protective and strengthening materials.