СТЕНДОВЫЕ ДОКЛАДЫ

ELECTROPLATING AND FUNCTIONAL PROPERTIES OF AMORPHOUS Fe-Mo(W) AND Fe-Mo-W COATINGS

Karakurkchi A.V., Ved M.V., Sakhnenko N.D., Yermolenko I.Yu., Zyubanova S.I.
National Technical University "Kharkov Polytechnic Institute", Kharkov, Ukraine
anyutikukr@gmail.com

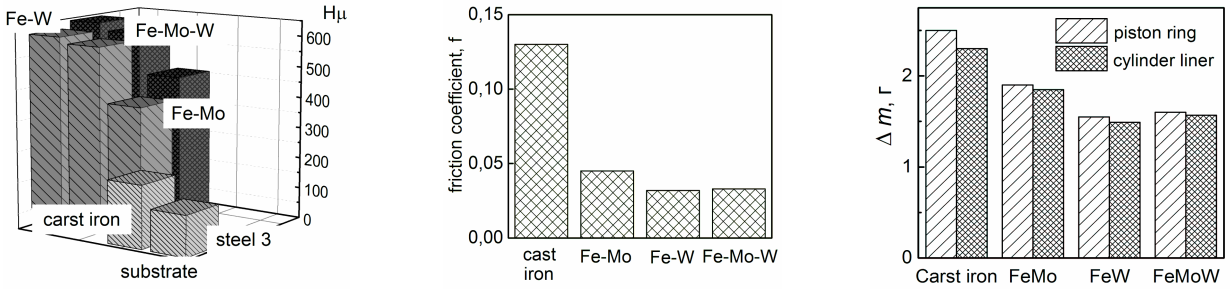
The aim of this work is to study the influence both of the electrolyte composition and electrolysis conditions on the quality, composition, morphology, corrosion behavior, mechanical, tribological properties and of galvanic alloys Fe-Mo(W) and Fe-Mo-W.

Coatings of Fe-Mo(W) and Fe-Mo-W were formed on steel and the cast iron substrates at a temperature of 20 – 25°C from a complex citrate bath of composition: iron (III) sulfate, sodium molybdate or/and sodium tungstenate, sodium citrate and boric acid; the pH value was adjusted within the range 3–4 by addition of sulfuric acid or sodium hydroxide. The coatings were formed in two modes: galvanostatic with the current density i 3–6 A·dm^{-2} and pulsed with unipolar pulse current of amplitude i of 3.5–9.0 A·dm^{-2} at a pulse duration t_{on} = 5–10 ms and pause time t_{off} = 10–20 ms.

On the basis of kinetic regularities the mechanism of Fe-Mo(W), Fe-Mo-W alloys' formation was established as co-precipitation of iron with molybdenum and tungsten in the range pH 3,0–4,0 happening on two routes, one – alloying metals reduction from heteronuclear complexes $[FeHCitMoO_4]^-$ is accompanied by chemical reaction of ligand releasing, and the second – reduction of iron (III) from the adsorbed complexes $[FeHCit]^+$ and in part – from $FeOH^{2+}$ accompanied by the chemical stage of ligand release.

Our study demonstrated that uniform bright and shiny coatings by double Fe-Mo(W) and ternary Fe-Mo-W alloys can be produced both in a dc and a pulsed mode with current efficiency of 65.0–87.0%. Application of unipolar pulsed current allows receiving a relatively high current efficiency and uniform coating with less nonmetallic impurities and an increased content of Mo and W in the alloy (Fig. 1).

Irrespective of the deposition mode electroplating alloys have an amorphous structure and the grains of coatings obtained in the pulsed mode consist of agglomerates with a diameter of 0.2-0.4 microns. The amorphous structure of alloys and significant content of alloying elements (Mo and W) predetermine improved physical and mechanical properties of coatings as well as high corrosion resistance. The corrosion rate of such coatings in all corrosive environments is lower and microhardness is three–four times higher that of the substrate (cast iron, mild steel) (Fig. 1).



a *b* *c*

Fig. 1 – The microhardness (*a*), friction coefficient (*b*) and wear resistance (*c*) for Fe alloys with Mo and W.

Taking into account the high level of anticorrosive, mechanical and tribological properties of galvanic coatings Fe-Mo(W) and Fe-Mo-W we can recommend them as protective coatings for cast iron and mild steel and considered as promising for technology in hardening and repair when restoring worn parts.