Application of modern computer technologies for analyzing features of the formation of micro-dug oxide coatings

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Abstract

The study is devoted to the analysis of the features of the formation of micro-dug oxide coatings. The role of modern computer technologies for processing the obtained experimental data is shown. Kinetics of formation of MDO coatings on AB alloy has been described. Phase composition of coatings depending on current density is studied and microhardness dependence on coating thickness is graphically shown.

Keywords: micro-dug oxidation, aluminium alloy, phase cohesion, aluminium oxides, corundum, mullite, microhardness

1 Introduction

Corrosion protection has an important nationality value and is solved by applying protective coatings or by doping materials. The most common covers are obtained by an electrochemical method.

The discovery of the method of electrochemical deposition on the surface of some thermodynamically stable films was the beginning of a new approach to solving these problems. Relatively strong anode films have become possible not only on valve metals, but also on their alloys.

2 Analytical overview

Modern industry places high demands on functional, protective and decorative coatings on metals. These coatings should combine a large number of properties, such as corrosion resistance, high hardness, wear resistance, etc.

One of the most promising surface hardening methods is the micro-dug oxidation method, which allows to obtain ceramic-like coatings on parts from valve metals and their alloys, which are distinguished by high insulating, mechanical, electrical and thermo physical characteristics, operational properties. The valve are called metals, oxide films of which are formed by an electrochemical pathway, have a unipolar conductivity in the system of metal - oxide - electrolyte, such as Al, Ti, Zr, Mg, etc. It has led to the widespread use of these coatings in mechanical engineering, instrument making, radio electronics, aviation, cosmic and other areas [1].

Very resistant inorganic protective coatings at high temperatures and in aggressive media are various ceramic coatings. However, the technology of their preparation is complex and time-consuming, and the clutch with the basis is often unsatisfactory [2].

In the literature, there is information that the properties of MDO coatings depend on their thickness, that is, the thickness of the coatings is crucial when evaluating their properties [3].

It should be noted that the convenience of systematization and processing of the obtained experimental data increases through the use of modern computer technology.

The study of the kinetics of the formation of coatings and the issue of optimizing the MDO process was carried out on an AV alloy in an alkaline-silicate electrolyte. It is shown that the thickness of the coating depends on the density of the current and processing time (fig. 1), that is, it is determined by the amount of electricity used (fig. 2) and is described by the Faraday law.

The results of X-ray phase analysis have shown that in an alkaline-silicate electrolyte in the micro raving discharge mode, the surface layer turns into high-temperature crystalline modifications of aluminum oxides: γ-Al2O3, α-α-α3 (corundum) Ta 3Al2O3 2SIO2 (Mullite) (fig. 3).

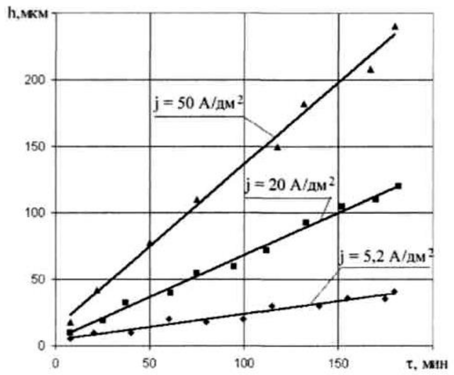

FIGURE 1 Kinetics of MDO-coating formation on AB alloyh is the thickness of the coating; τ – the processing time; j – current density

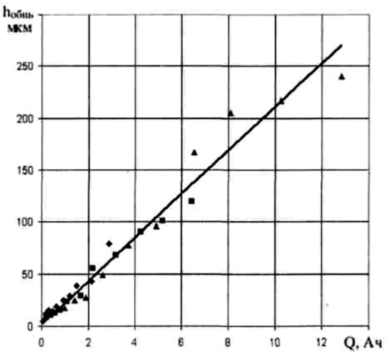

FIGURE 2 Dependence of the general thickness of a covering on quantity of the used electricity on AB alloy

♦ – j = 5.2 A/dm^2; ■ – j = 20 A/dm^2; ▲ – j = 50 A/dm^2

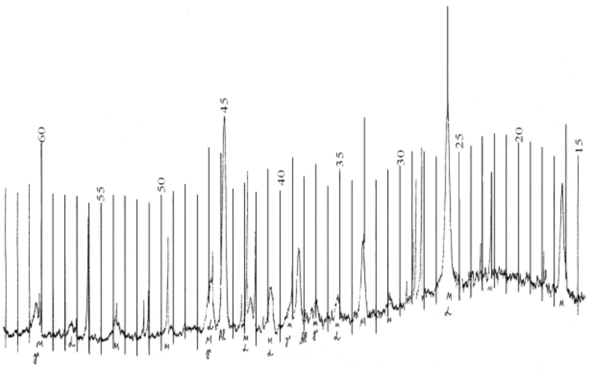

FIGURE 3 Diffractogram Fragment MDO coating (λ-Cu), main layer

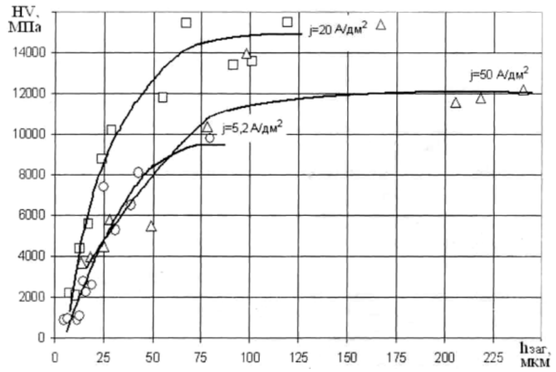

FIGURE 4 Microhardness of MDO coatings

Analysis of X-ray diffractograms shows that the phase composition of the MDO coatings is non-generated in thickness, as well as different for coatings of different thickness. Ensuring the same properties of coatings across the entire surface being treated requires the production of equal coatings.
Thus, the studied studies unequivocally showed that there is a complete correlation between the thickness of the formed MDO coating and the amount of electricity that was required to form the coating. Variating current density, we can significantly increase the performance of the process, although the costs cannot be reduced. But recommendations for increasing the current density to accelerate the MDO process are suitable after comparing the properties of coatings that are formed with different current density. As a criterion, the microhardness of the coatings was used (fig. 4).

3 Formulation of the problem

The purpose of this work was to study the effect of current density on the phase composition and properties of the coatings.

4. Conclusions

1. Coatings on aluminum alloy AB in an alkaline-silicate electrolyte in anodic-cathode mode was formed using the method of micro-dug oxidation (MDO).
2. It is shown that the coating thickness is determined by the electrolysis mode and is proportional to the number of electrical current passed. To form a coating with a thickness of about 250 μm, it is necessary approximately 15-20 A h (duration of processing 3 hours).
3. The phase composition of the coating has been studied and it is established that the phase composition is non-uniform and depends on the thickness of the coating. The main phases are crystalline aluminum oxides γ-Al2O3, α-α-α3 (corundum) Ta 3Al2O3 2SIO2 (Mullit)

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