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## **STUDY OF THE KINETICS OF THICKNESS FORMATION AND PHASE COMPOSITION OF COATINGS ON DEFORMABLE ALUMINIUM ALLOYS DURING MICROARC OXIDATION**

*PhD student: Viacheslav Barannikov*

*Research supervisor: Professor Valeriia Subbotina  
Materials Science Department*

*English language supervisor: Associated Professor Natalya Turlakova  
Cross-Cultural Communication and Foreign Language Department  
National Technical University “Kharkiv Polytechnic Institute”*

*Abstract.* The study deals with the processes of coating formation on deformable aluminium alloy AMg6 by microarc oxidation (MAO). The kinetics of coating thickness growth and changes in its phase composition depending on electrolysis conditions have been investigated. The main regularities of the influence of oxidation modes on the morphology and phase composition of the obtained coatings have been established. The mechanism of formation of various phases in the process of MAO and their influence on the properties of coatings have been studied. The obtained results can be used to optimize the technology of formation of protective coatings on aluminium alloys used in various industries.

*Keywords:* aluminium alloy, microarc oxidation, coating thickness, phase composition, X-ray tensometry, hardness.

*Introduction.* The development of technologies for surface modification of metals and alloys is an urgent task of modern materials science. One of the most progressive methods of formation of wear-resistant and protective coatings on aluminium alloys is the method of micro arc oxidation (MAO). This method allows to obtain coatings with high hardness, corrosion resistance and wear-resistance, which makes it in demand in the aerospace, automotive and machine-building industries. Despite the widespread use of MAO technology, the issues related to the kinetics of coating thickness growth and formation of their phase composition remain unresolved so far.

*The object of research* is multilayer MDO coating on deformable aluminium alloy AMg6.

*The aim of the work* is to establish the main regularities of coating formation and properties on aluminium alloy in the process of micro-arc oxidation.

*Presentation of the main research material.*

In order to achieve the goal, the research was carried out using the following methods:

- X-ray qualitative and quantitative phase analysis (X-ray diffractometer DRON-4);
- microhardness measurement method (PMT-3);
- method of layer thickness measurement (VT-10NC vortex thickness gauge).

Micro-arc oxidation was carried out in aqueous solutions of electrolytes containing alkali (KOH) and sodium silicate ( $\text{Na}_2\text{SiO}_3$ ) at constant current density  $j = 20 \text{ A/dm}^2$ , processing time varied from 30 to 180 minutes. The results showed that the coating was two-layer and consisted of  $\alpha$ - $\text{Al}_2\text{O}_3$ ,  $\gamma$ - $\text{Al}_2\text{O}_3$  and mullite ( $3\text{Al}_2\text{O}_3 \cdot 2\text{SiO}_2$ ) phases. It is shown that the composition of the alkali-silicate electrolyte and the duration of electrolysis significantly affect the growth kinetics, phase composition and hardness of the coatings. Increasing the concentration of liquid glass ( $\text{Na}_2\text{SiO}_3$ ) in the electrolyte accelerates the process of formation of MAO-coatings and creates thermodynamically favorable conditions for polymorphic transformation  $\gamma$ - $\text{Al}_2\text{O}_3 \rightarrow \alpha$ - $\text{Al}_2\text{O}_3$ , which in turn promotes the formation of coatings with  $\alpha$ - $\text{Al}_2\text{O}_3$  phase, which has high mechanical strength (HV up to 15 GPa).

*Conclusions.*

1. It is found that the phase composition of the coating depends on the mechanism of its formation.
2. Changing the concentration of liquid glass in the electrolyte significantly affects the mechanism and processes of coating formation. The coating is formed by an electrochemical mechanism.
3. The highest hardness (15 GPa) of MDO coatings on AMg6 alloy is obtained in a combined electrolyte containing liquid glass and potassium hydroxide.

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## **COMPUTATIONAL MODELING OF THE DEFORMATION OF THE “BONE–IMPLANT–PROSTHESIS” SYSTEM**

*PhD student Kostiatyn Barbin  
Department of Mathematical Modeling and Intelligent  
Computing in Engineering  
National Technical University “Kharkiv Polytechnic Institute”  
Kharkiv, Ukraine*

*Abstract.* The study investigates the deformation behavior of a “bone–implant–prosthesis” system using finite element analysis. It shows that increased friction at the bone–implant interface, due to osseointegration, improves system strength under static loading.

*Keywords:* finite element method, bone–implant–prosthesis system, osseointegration, friction coefficient, biomechanical modeling, stress analysis, prosthetic design.

*Introduction.* Currently, the issue of prosthetics for lost limbs is becoming increasingly acute in Ukraine. Improving the quality of prostheses is essential for enabling individuals with amputations to return to a full life as quickly and comfortably as possible. Since every individual is unique in terms of biometric parameters, achieving optimal ergonomic performance requires that each prosthesis be customized. This uniqueness must be supported by appropriate computational studies, including the deformation process. Based on such computational analysis, it becomes possible to determine rational values for key geometric and operational parameters of prosthesis.

One of the modern directions in prosthetics development is the use of so-called implants-components that directly integrate with the bone. In this approach, the prosthesis is attached directly to the implant. This technique offers several advantages over conventional external prostheses: for example, it reduces or eliminates friction between the prosthesis and soft tissues of the stump, and simplifies and improves control of the prosthesis during movement.