EFFECT OF ULTRASOUND POWER DURING THE MICRO-ARC OXIDATION ON WETTABILITY AND ELECTRICAL PROPERTIES OF CALCIUM PHOSPHATE COATINGS*

E.B. AKIMOVA[1], *E.G. KOMAROVA*[1], *E.A. KAZANTSEVA*[1], *A.L. ZHARIN*[2], *Yu.P. SHARKEEV*[1]

[1]*Institute of Strength Physics and Materials Science SB RAS, Tomsk, Russia*
[2]*Belarussian National Technical University, Minsk, Belarus*

With the rapid development of the sonoelectrochemistry, ultrasonic treatment as a new assistant technology has applied very widely in many fields. The ultrasound (US) employing to electroplating systems can give rise to an increase of effective current density and mass transport processes, and as a result changes in chemical and physical properties of deposited ceramic coatings. The aim of the work was to study the influence of the different US powers applied during the MAO process on the wettability and the surface electrostatic potential (SEP) of the formed calcium phosphate (CaP) coatings. The CaP coatings were deposited on the pure titanium (Ti) by the control MAO method and US-assisted MAO (UMAO) method at different US powers of 50, 100 and 200 W as in the previous work [1].

The wettability studies were carried out by the sessile drop method with two test liquids (dionized water and glycerol). The contact angles of the water and glycerol on the control MAO coatings were 22.8 and 25.7 °, respectively. Whereas, the drops of the water and glycerol on the UMAO coatings had lower contact angles of 11.4–12.4 ° and 17.9–18.8 °, respectively (Fig. 1a). Thus, all the UMAO coatings were more superhydrophilic compared to the control MAO coating. The Owens-Wendt equation was used to calculate the free surface energy (FSE) as well as its polar and dispersive components. The control MAO coating had high FSE of 68.2 mN/m, and the UMAO coatings had higher FSE of 72.3–75.5 mN/m. The values of contact angles and FSE did not depend on the US power magnitude in the range of 50–200 W. For all the coatings, the polar component of the FSE exceeded the dispersion component by four times. Figure 1b shows the 3D-profile of the SEP of the UMAO (100 W) coating. The SEP measured by the Kelvin probe method was distributed fairly uniformly through the surface of all the coatings, repeating their complex micro-rough relief. All the CaP coatings were defined as negative electret dielectrics. In this case, the UMAO coatings had higher negative SEP from –115.2 to –110.9 mV than the control MAO coating with SEP of –85.3 mV.

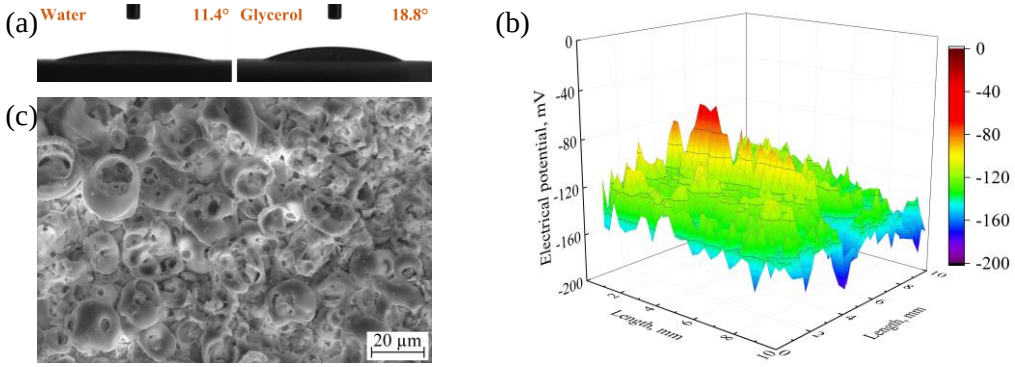

Fig.1. Image of the water and glycerol droplets (a), 3D distribution of the SEP (b) and SEM image (c) of the surface of the UMAO (100 W) coating

Thus, it was shown that the application of US during the MAO process leads to an improvement in the hydrophilic properties of the CaP coatings and an increase in the negative SEP. We associate it with a change in surface morphology caused by the destruction of structural elements (spheres and pores) (Fig. 1c) and an increase in the surface roughness (R_a) from 3.0 to 4.5 μm [1]. While the magnitude of the applied US does not affect the change in these properties that can be due to the similar morphology and roughness of all the UMAO coatings as was showed in [1].

REFERENCES

[1] E. A. Kazantseva, E. G. Komarova, “Effect of power of ultrasound during micro-arc oxidation on morphology, elemental and phase composition of calcium phosphate coatings,” Journal of Physics: Conference Series, vol. 2064, pp. 012057(6), Nov. 2021, doi: 10.1088/1742-6596/2064/1/012057.

* The work was performed according to the Government research assignment for ISPMS SB RAS, Project FWRW-2021-0007.