ELECTROCHEMICAL FORMATION AND CHARCTERIZATION OF CALCIUM HYDROXYAPATITE ON Mg ALLOY

Greta Briedytė[1*], Asta Grigucevičienė[2], Alma Ručinskienė[2]

[1] *Vilnius University, Naugarduko 24, LT-03225 Vilnius, Lithuania*
[2]*Center for Physical Sciences and Technology, Department of Electrochemical Materials Science, Saulėtekio al. 3, LT-10257 Vilnius, Lithuania*

Biodegradable implants are one of the promising areas of Mg and its alloys application. Implant materials must be biocompatible, which is defined as the ability of materials not to cause severe adverse reactions in organisms. Mg is a non-toxic, easily adsorbed element, naturally occurring in the tissues of living organisms and involved in physiological processes. The aim of this work was to electrochemically form calcium hydroxyapatite (CHAp) coatings on AZ31 alloy, identify their composition, structural morphology and corrosive behavior in balance Hanks' salt solution. X-ray diffraction method showed that coating consists of ~ 41% of calcium hydroxyapatite $Ca_{10}(PO_4)_6(OH)_2$ and ~ 59% of calcium hydroxylapatite $Ca_5(PO_4)_3(OH)$. SEM-EDX and 3D optical microscopy methods revealed that CHAp coatings have dendritic morphology, they are uneven, coarse, highly porous and have large variations in coating thickness (Fig.1). The corrosion behaviour of AZ31 alloy was investigated by electrochemical methods. It was found that CHAp coating increases the resistance of AZ31 to pitting corrosion. CHAp coatings with the best parameters were formed by galvanostatic method with deposition current of -0.5 mA·cm^{-2}. As can be seen from Tafel dependences in Figure 2, the open circuit potential of the galvanostatically coated AZ31/CHAp electrodes shifted to a range of more positive values compared to the uncoated AZ31 electrode (curve 4). The largest positive shift of ~0.1V was found for the CHAp coating, with deposition time of 120 min (thickness for reference 13.8μm).

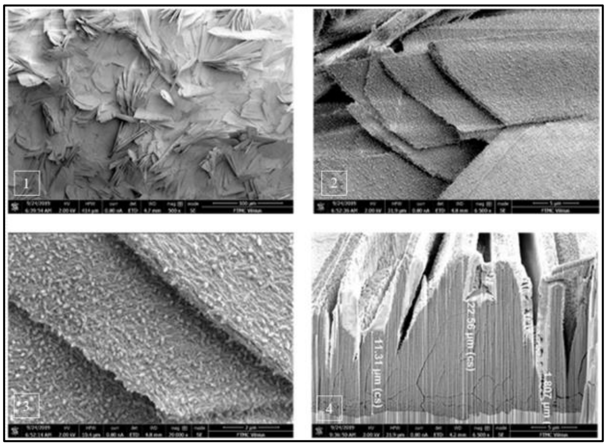

Fig.1. SEM images of surface (1-3) and cross-section (4) of CHAp coating deposited by galvanostatic method (i_k=0.5 mA·cm^{-2}, 60 min) at different magnifications: 1 - 500x, 2, 4 - 6500x, 3 - 20000x.

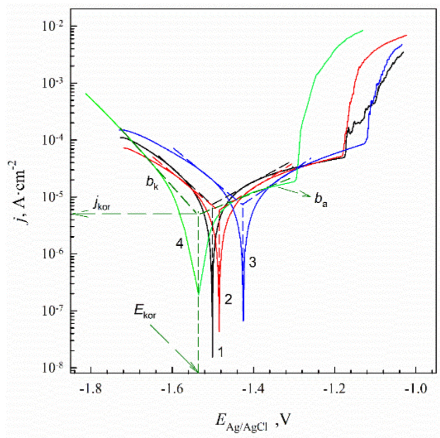

Fig. 2. Tafel plots of AZ31/CHAp electrodes formed by galvanostatic method. CHAp coating deposition current density i_k=0.5 mA·cm^{-2}, deposition times: 1- 30 min; 2 - 60 min; 3 - 120 min; 4 - AZ31.

Acknowledgment. The authors thank Dr. Aušra Selskienė for SEM-EDX measurements.

References

1. Z. Grubač. M. Metikos-Hukovic, R. Babic. Electrolyzation growth and characterization of calcium phosphate ceramics on magnesium alloys. Electrochimica Acta 109:694-700 (2013).
2. K. Kusnierczyk and M. Basista. Recent advances in research on magnesium alloys and magnesium–calcium phosphate composites as biodegradable implant materials. Journal of Biomaterials Applications 31(6): 878-900 (2016).