The Al_2O_3/ZnO multilayer deposited by ALD on surgical scalpels

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Abstract

Statement of the Problem: Anti-corrosion protection is an important field of surface engineering. Corrosion contributes to significant economic losses, it has been estimated that in developed countries the costs of corrosion are equivalent to 3-4% of gross domestic product (GDP) per year for a given country. Therefore, appropriate surface modifications of products made of materials susceptible to corrosion lead to significant savings. The corrosion protection and delamination resistance can be improved by using multi-layer coatings. It is assumed that the improvement in adhesion of the coating to the substrate is caused by the relaxation of internal stresses that occurs at the interface of subsequent layers. Reducing porosity also contributes to better corrosion resistance of multilayer coatings - subsequent layers seal the pores existing in those previously deposited. By using multi-layer coatings, you can obtain the most advantageous combination of properties of individual coating components. The impact of the use of multilayer Al_2O_3/ZnO coatings deposited using the atomic method on the corrosion resistance of surgical scalpel blades were analyzed. As part of the work, multilayer Al_2O_3/ZnO coatings were deposited on carbon steel substrates using the atomic layer deposition (ALD) method. The surface morphology, chemical composition and corrosion properties were examined. The surface topography of the coatings was examined using a scanning electron microscope. A qualitative analysis of the chemical composition of the obtained coatings was performed using the EDS method. In order to determine the corrosion resistance, potentiodynamic tests were performed using Ringer's solution at a temperature of 37°C. The influence of the number of deposited layers on the surface morphology and corrosion resistance of the coating was described. With the increase in the number of Al_2O_3/ZnO layers in the coatings deposited using the ALD method, an increase in the corrosion resistance of the coatings was recorded.

Conclusion & Significance: Results of the surface examination using SEM are shown in Figure 1. Granular morphology of deposited coatings can be seen – with grains of elongated shape, characteristic for zinc oxide, which represents the outer layer of deposited coatings. Grains were distributed randomly, with no dominant direction of their arrangement. With increasing number of layers deposited, the value of corrosion current density decreases and increasing corrosion resistance.

Image

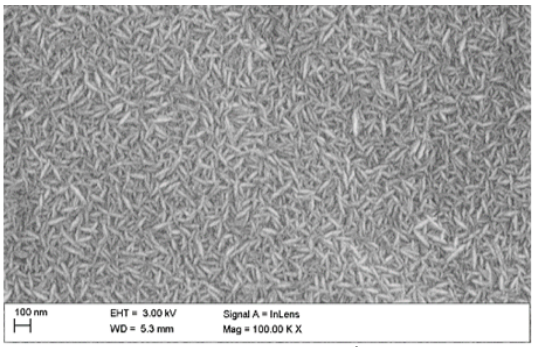

Figure 1. SEM image of the Al_2O_3/ZnO multicoating deposited by ALD after 72 cycles.

Recent Publications

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Photograph

Biography

Dr Magdalena Szindler actively involved in the research in the field of engineering and technical sciences. Her main scientific interests are related to materials engineering, including polymer and ceramic materials with properties enabling their use in electronics, photovoltaics, medicine. She is also the operator of devices for deposition of layers using sol-gel methods (spin coater, dip coater), vacuum methods (PVD, ALD) and devices for measuring the electrical properties of thin layers, as well as infrared, Raman and UV/Vis spectrophotometers. Her area of interest also includes reverse engineering methods, in particular additive technologies (FDM/FFF, SLA) and related object-oriented design.