Composite layers “MgAl intermetalic layer / PVD coating” obtained by hybrid surface treatment method on the AZ91D magnesium alloy

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Extended Abstract

The magnesium alloys are very interesting construction materials in aviation, automotive and machine industries as well as in production of portable electric devices. Their low densities from 1.75 to 1.85 g/cm3 and high specific strength give a chance of considerable reduce of energy. The main inconvenient feature of magnesium alloys which make difficult their applications is very small corrosion and tribology resistance.

This paper presents the technological process of creation of the composite layers consist of “intermetalic layer MgAl – PVD coating” on AZ91D magnesium alloy intended for anticorrosion and anti-wear applications. The investigated composite layers were obtained with the use of the hybrid surface treatment technology, which consist of diffusion treatment in Al powder followed by electron beam deposition method. In order to present the technical realization of hybrid technology the authors designed an original technological process implemented in the hybrid multisource device (Fig.1), produced at the Institute for Sustainable Technologies – National Research Institute in Radom (Poland).

Fig.1. The hybrid multisource device produced at the Institute for Sustainable Technologies – National Research Institute in Radom.

The device has been equipped with two arc sources with the cathode diameter of ϕ=80 mm and with the 60kW electron gun with the dynamic electron beam deflection circuit and steering system. The device is equipped with modern, reliable power systems, substrate

polarization system, multichannel process gases dosing system as well as the systems of monitoring and measuring substrate temperature and atmospheric gas pressure.

The Al_2O_3 ceramic coatings was obtained on the AZ91D magnesium alloy with the intermetalic layer MgAl on the surface. The properties of the designed and created composite layers like as microstructure (optical microscopy technique), phase structure (X-ray diffraction), chemical composition (GDOES method) were investigated (Fig.2).

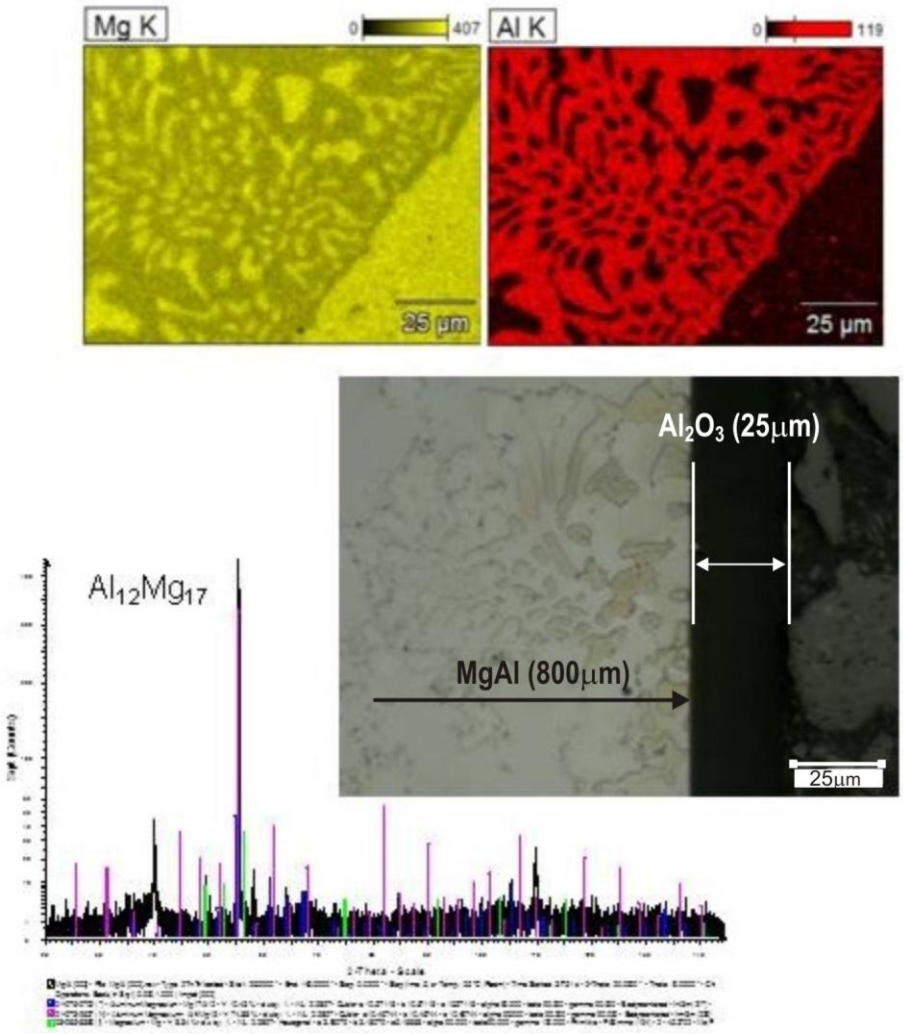

Fig.2. The Al_2O_3 ceramic coatings obtained on the AZ91D magnesium alloy with the intermetalic layer MgAl on the surface.

The paper also demonstrates the results of adhesion (Scratch test), mechanical properties (Nano Hardness Tester), corrosion investigations (electrochemical corrosion test method) as well as tribology investigations (ball-on-disk method) carried out for AZ91D magnesium alloy covered by investigated composite layers.

The obtained results proved that hybrid surface treatment technology – diffusion treatment in Al powder + electron beam deposition, which was developed by authors, enable to significant increase of corrosion and tribology resistance of AZ91D magnesium alloy.