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STUDY OF THE SURFACE PROPERTIES OF AM60B AND AZ91D MAGNESIUM ALLOYS COATED BY PVD WITH TITANIUM FILMS AND ALLOYED BY LEHCEB

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Magnesium alloys combine useful properties such as low density (Mg 1.73 g/cm^3), excellent strength-to-weight ratio, relatively large thermal and electrical conductivities, satisfactory formability, and excellent biocompatibility. These properties make magnesium alloys among the most used light-weight materials for automotive, aerospace, consumer electronic and sport goods, and biomedical implants.

Magnesium has a very low standard reduction potential (-2.37 V vs SHE at 25°C) while commonly used magnesium alloys have corrosion potential E_{corr} in 1M NaCl aqueous solution at 25°C in the range between -1.7 and -1.6 V vs SCE. Their corrosion resistance is a still a technological problem, especially when magnesium alloys are in galvanic contact with other metals. Microgalvanic corrosion of magnesium alloys is also an intrinsic problem related to the presence of secondary more noble phases within the solid solution. Moreover, corrosion resistance is particularly poor when they are exposed to aggressive environments, such as chlorides electrolytes. The issue of microgalvanic corrosion in magnesium alloys has been already addressed by treating the surface of the AM60B and AZ91D alloys by means of the low energy high current electron beam technique (LEHCEB) able to dissolve the $Mg_{17}Al_{12}$ intermetallic compound into the solid solution matrix and to change the surface composition by preferentially evaporating Mg in respect to Al from the irradiated surface. [1]

Titanium has a positive effect on the corrosion resistance of magnesium alloys. Xu et al. co-deposited by magnetron sputtering Mg and Ti on glass slides with different compositions. Ti is a strong passivating element increasing the passivity of Mg as well and reducing its dissolution in saturated $Mg(OH)_2$ solutions with and without addition of NaCl. [2] According to Liu et al., gradient composition structures obtained by Ti implantation in AZ91 alloys greatly improves the corrosion resistance. [3] Song et al. deposited Mg-Ti alloys by RF magnetron sputtering on quartz plates, and they found that the passivity of Mg-Ti alloy was enhanced and the corrosion rate decreased with the increase of Ti content. [4]

In the present work we investigated the possibility to form surface alloys between titanium and the commercially used AM60B and AZ91D magnesium alloys by LEHCEB technique. A pretreatment with the LEHCEB was performed to prepare the surface of the alloys (15 kV, 10 pulses) and then thin films of Ti were deposited (100, 500 and 1000 nm) by DC magnetron sputtering. Surface alloying by LEHCEB between titanium films and AM60B and AZ91D alloys was investigated by varying the acceleration voltage (20 and 25 kV) and number of pulses (5 and 10).

The obtained surface alloys have been characterized in term of composition (EDS, XRD), morphology (SEM), Vickers instrumented microindentation and corrosion resistance.

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