SYNTHESIS OF MULTICOMPONENT SURFACE ALLOY ON A MAGNESIUM SUBSTRATE PRODUCED BY USING A LOW-ENERGY HIGH-CURRENT ELECTRON BEAM

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Magnesium alloys are the lightest metal available for engineering applications and show promise as a structural material in aerospace and automotive industries, because those sectors are seeking increased fuel efficiency through weight reduction. However, due to the low wear resistance and high chemical activity of magnesium alloys, surface treatment of Mg alloy components is usually required in order to increase their durability. It appears that the simplest method of preventing corrosion of the magnesium substrate prohibit contact with the environment by applying the protective coating [1]. Unfortunately, it is still difficult to find a coating technology that can provide good protection of magnesium alloys from corrosion, abrasion and, along with them, satisfactory adhesion of the coating to the substrate. For example, anodizing coatings have excellent wear resistance, but these coatings are not suitable for load-bearing applications. Most wet coating processes are harmful to the environment. Applying a appropriate coating using laser cladding can improve the corrosion resistance of Mg alloys, but it has been found that quality problems such as cracking and porosity cannot be overcome, especially for cladding large surfaces. One of the methods that allow the formation of uniform coatings with good adhesion is the method of forming surface alloys [2,3].

The aim of present work was to synthesize of Ni-Cu-Al surface alloy directly on magnesium substrate using magnetron deposition of multicomponent Ni-Cu-Al films and consequent irradiation with a low-energy, high-current electron beam (LEHCEB).

The electron-beam machine "RITM-SP" with an explosive-emission cathode and a plasma-filled diode generating the LEHCEB was employed in the work [4]. This machine is equipped with a multi-magnetron sputtering system enabling formation of multicomponent surface alloys. Considering that the binary phase diagram of Ni - Cu refers to a system with complete solubility of the components in the liquid and solid phases, a fairly good homogeneous microstructure with good corrosion resistance is expected. Below the copper layer lies an aluminum layer. Aluminum was chosen mainly because its melting point (660 °C) is slightly higher than that of magnesium (649 °C), and about two-thirds of the melting point of copper (1083 °C). In addition, aluminum is a widely used alloying element for casting magnesium alloys.

The surface morphology, phase and elemental composition of the Ni-Cu-Al surface alloys were analyzed, the microhardness and wear resistance were measured. For its characterization different techniques like SEM, XRD and others have been used. The elemental composition of both the surface and cross sections of the samples was analyzed by EDS analysis. The structure and properties of the synthesized Ni-Cu-Al surface alloy was compared with witness-specimens, which is coatings but without LEHCEB treatment.

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